BID PROPOSAL
CONTRACT DOCUMENTS AND SPECIFICATIONS FOR

NEW BOUTIQUE HOTEL IRALENA
(former Marianna Office Supply Bldg.)

PREPARED FOR:

CITY OF MARIANNA
Travis Ephriam, Mayor
Allen Ward, II, Mayor Pro Tem
Rick Pettis
Rico Williams
Kenneth Hamilton
William Long, City Manager

FUNDED BY:

Florida Department of Commerce
CDBG-DR Grant No. M0047

PREPARED BY:

DHM
MELVIN ENGINEERING
4428 Lafayette Street
Marianna, Florida 32446
Phone (850) 482-3045

RELEASED FOR BIDS:
APRIL 29, 2026

DONOFRO ARCHITECTS

HG ENGINEERS

JP JOHNSON PEADEN ENGINEERING INC.

RICHARD P. RAMIREZ, P.E.
STRUCTURAL ENGINEER

ADVERTISEMENT FOR BIDS

Marianna Downtown Improvements
Reconstruction of Marianna Office Supply Bldg.
Adaptive Re-Use Project
New Boutique Hotel Iralena

City of Marianna (Owner) is requesting Bids for the construction of the following Project:

Reconstruction of Marianna Office Supply Bldg
FloridaCommerce Grant - CDBG-DR M0047

Bids for the Project will be received at the **City of Marianna Clerk's Office** located at **2895 Jefferson St, Marianna, FL 32446**, **until Tuesday, May 26,2026**, **2:00 PM** local time. At that time, or shortly thereafter, the Bids received will be publicly opened and read at the Marianna City Hall Commission Chambers located at 2897 Jefferson Street, Marianna, FL 32446.

The Project includes the following Work:

The reconstruction of the former Marianna Office Supply Bldg damaged by Hurricane Michael into a boutique hotel. The building is a total of 23,700 sf consisting of two stories plus a full basement area. Includes complete reconstruction including architectural, structural, mechanical, electrical and plumbing.

Bid documents may be obtained from:

DHM Melvin Engineering
4428 Lafayette Street, Marianna, Florida 32446
Email request: martivickery@melvineng.com
Office phone: (850) 482-3045

Bid documents will be emailed in pdf format at no cost.

Pre-bid Conference
A non-mandatory pre-bid conference for the Project will be held on **Thursday, May 7, 2026, at 10 AM local time** at the office **Melvin Engineering located at 4428 Lafayette Street, Marianna, FL 32446. A site visit will follow the conclusion of the pre-bid meeting.**

Instructions to Bidders.
For all further requirements regarding bid submittal, qualifications, procedures, and contract award, refer to the Instructions to Bidders that are included in the Bidding Documents.

Small business and minority businesses, women's business enterprises, and labor surplus area firms are encouraged to submit proposals, and firms using such subcontractors are strongly encouraged to solicit such firms in the subcontracting process. Any Contracts/subcontracts issued under this procurement must comply with the necessary affirmative steps to assure that minority businesses, women's business enterprises, and labor surplus area firms are used when possible, in accordance with 2 CFR § 200.321.

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All employees of the bidder, as well as all employees of any subcontractors working on the project, must provide documentation verifying their legal status and eligibility to work in the United States through the E-Verify system.

EQUAL OPPORTUNITY EMPLOYER HANDICAP ACCESSIBLE/FAIR HOUSING JURISDICTION

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ARTICLE 1—DEFINED TERMS

1.01 Terms used in these Instructions to Bidders have the meanings indicated in the General Conditions and Supplementary Conditions. Additional terms used in these Instructions to Bidders have the meanings indicated below:

A. *Issuing Office*—The office from which the Bidding Documents are to be issued, and which registers plan holders.

ARTICLE 2—BIDDING DOCUMENTS

2.01 Bidder shall obtain a complete set of Bidding Requirements and proposed Contract Documents (together, the Bidding Documents). See the Agreement for a list of the Contract Documents. It is Bidder's responsibility to determine that it is using a complete set of documents in the preparation of a Bid. Bidder assumes sole responsibility for errors or misinterpretations resulting from the use of incomplete documents, by Bidder itself or by its prospective Subcontractors and Suppliers.

2.02 Bidding Documents are made available for the sole purpose of obtaining Bids for completion of the Project and permission to download or distribution of the Bidding Documents does not confer a license or grant permission or authorization for any other use. Authorization to download documents, or other distribution, includes the right for plan holders to print documents solely for their use, and the use of their prospective Subcontractors and Suppliers, provided the plan holder pays all costs associated with printing or reproduction. Printed documents may not be re-sold under any circumstances.

2.03 Bidder may register as a plan holder and obtain complete sets of Bidding Documents, in the number and format stated in the Advertisement or invitation to bid, from the Issuing Office. Bidders may rely that sets of Bidding Documents obtained from the Issuing Office are complete, unless an omission is blatant. Registered plan holders will receive Addenda issued by Owner.

2.04 Plan rooms (including construction information subscription services, and electronic and virtual plan rooms) may distribute the Bidding Documents, or make them available for examination. Those prospective bidders that obtain an electronic (digital) copy of the Bidding Documents from a plan room are encouraged to register as plan holders from the Bidding Documents Website or Issuing Office. Owner is not responsible for omissions in Bidding Documents or other documents obtained from plan rooms, or for a Bidder's failure to obtain Addenda from a plan room.

2.05 Electronic Documents

A. When the Bidding Requirements indicate that electronic (digital) copies of the Bidding Documents are available, such documents will be made available to the Bidders as Electronic Documents in the manner specified.

1. Bidding Documents will be provided in Adobe PDF (Portable Document Format) (.pdf) that is readable by Adobe Acrobat Reader. It is the intent of the Engineer and Owner that such Electronic Documents are to be exactly representative of the paper copies of the documents. However, because the Owner and Engineer cannot totally control the transmission and receipt of Electronic Documents nor the Contractor's means of reproduction of such documents, the Owner and Engineer cannot and do not guarantee that Electronic Documents and reproductions prepared from those versions are identical in every manner to the paper copies.

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B. Unless otherwise stated in the Bidding Documents, the Bidder may use and rely upon complete sets of Electronic Documents of the Bidding Documents, described in Paragraph 2.06.A above. However, Bidder assumes all risks associated with differences arising from transmission/receipt of Electronic Documents versions of Bidding Documents and reproductions prepared from those versions and, further, assumes all risks, costs, and responsibility associated with use of the Electronic Documents versions to derive information that is not explicitly contained in printed paper versions of the documents, and for Bidder's reliance upon such derived information.

ARTICLE 3—QUALIFICATIONS OF BIDDERS

3.01 To demonstrate Bidder's qualifications to perform the Work, Bidder must submit the following information (as applicable):

A. Written evidence establishing its qualifications such as financial data, previous experience, and present commitments.

B. A written statement that Bidder is authorized to do business in the state where the Project is located, or a written certification that Bidder will obtain such authority prior to the Effective Date of the Contract.

C. Bidder's state or other contractor license number, if applicable.

D. Subcontractor and Supplier qualification information.

E. Other required information regarding qualifications.

3.02 A Bidder's failure to submit required qualification information within the times indicated may disqualify Bidder from receiving an award of the Contract.

3.03 No requirement in this Article 3 to submit information will prejudice the right of Owner to seek additional pertinent information regarding Bidder's qualifications.

ARTICLE 4—PRE-BID CONFERENCE

4.01 A non-mandatory pre-bid conference will be held at the time and location indicated in the Advertisement or invitation to bid. Representatives of Owner and Engineer will be present to discuss the Project. Bidders are encouraged to attend and participate in the conference; however, attendance at this conference is not required to submit a Bid.

4.02 Information presented at the pre-Bid conference does not alter the Contract Documents. Owner will issue Addenda to make any changes to the Contract Documents that result from discussions at the pre-Bid conference. Information presented, and statements made at the pre-bid conference will not be binding or legally effective unless incorporated in an Addendum.

ARTICLE 5—SITE AND OTHER AREAS; EXISTING SITE CONDITIONS; EXAMINATION OF SITE; OWNER'S SAFETY PROGRAM; OTHER WORK AT THE SITE

5.01 Site and Other Areas

A. The Site is identified in the Bidding Documents. By definition, the Site includes rights-of-way, easements, and other lands furnished by Owner for the use of the Contractor. Any additional lands required for temporary construction facilities, construction equipment, or storage of

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materials and equipment, and any access needed for such additional lands, are to be obtained and paid for by Contractor.

5.02 Existing Site Conditions

A. *Subsurface and Physical Conditions; Hazardous Environmental Conditions*

1. The Supplementary Conditions identify the following regarding existing conditions at or adjacent to the Site:

a. Those reports of explorations and tests of subsurface conditions at or adjacent to the Site that contain Technical Data.

b. Those drawings known to Owner of existing physical conditions at or adjacent to the Site, including those drawings depicting existing surface or subsurface structures at or adjacent to the Site (except Underground Facilities), that contain Technical Data.

c. Reports and drawings known to Owner relating to Hazardous Environmental Conditions that have been identified at or adjacent to the Site.

d. Technical Data contained in such reports and drawings.

2. Owner will make copies of reports and drawings referenced above available to any Bidder on request. These reports and drawings are not part of the Contract Documents, but the Technical Data contained therein upon whose accuracy Bidder is entitled to rely, as provided in the General Conditions, has been identified and established in the Supplementary Conditions. Bidder is responsible for any interpretation or conclusion Bidder draws from any Technical Data or any other data, interpretations, opinions, or information contained in such reports or shown or indicated in such drawings.

3. If the Supplementary Conditions do not identify Technical Data, the default definition of Technical Data set forth in Article 1 of the General Conditions will apply.

4. *Geotechnical Baseline Report/Geotechnical Data Report:* The Bidding Documents contain a Geotechnical Baseline Report (GBR) and Geotechnical Data Report (GDR).

a. As set forth in the Supplementary Conditions, the GBR describes certain select subsurface conditions that are anticipated to be encountered by Contractor during construction in specified locations ("Baseline Conditions"). The GBR is a Contract Document.

b. The Baseline Conditions in the GBR are intended to reduce uncertainty and the degree of contingency in submitted Bids. However, Bidders cannot rely solely on the Baseline Conditions. Bids should be based on a comprehensive approach that includes an independent review and analysis of the GBR, all other Contract Documents, Technical Data, other available information, and observable surface conditions. Not all potential subsurface conditions are baselined.

c. Nothing in the GBR is intended to relieve Bidders of the responsibility to make their own determinations regarding construction costs, bidding strategies, and Bid prices, nor of the responsibility to select and be responsible for the means, methods, techniques, sequences, and procedures of construction, and for safety precautions and programs incident thereto.

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d. As set forth in the Supplementary Conditions, the GDR is a Contract Document containing data prepared by or for the Owner in support of the GBR.

B. *Underground Facilities:* Underground Facilities are shown or indicated on the Drawings, pursuant to Paragraph 5.05 of the General Conditions, and not in the drawings referred to in Paragraph 5.02.A of these Instructions to Bidders. Information and data regarding the presence or location of Underground Facilities are not intended to be categorized, identified, or defined as Technical Data.

5.03 Other Site-related Documents

A. No other Site-related documents are available.

5.04 Site Visit and Testing by Bidders

A. It is recommended that bidders visit the Site and conduct a thorough visual examination of the Site and adjacent areas. During the visit the Bidder must not disturb any ongoing operations at the Site.

B. A Site visit is scheduled following the pre-bid conference. Maps to the Site will be available at the pre-Bid conference.

C. Bidders visiting the Site are required to arrange their own transportation to the Site.

D. All access to the Site other than during a regularly scheduled Site visit must be coordinated through the following Owner or Engineer contact for visiting the Site: **SEE ADVERTISEMENT**. Bidder must conduct the required Site visit during normal working hours.

E. Bidder is not required to conduct any subsurface testing, or exhaustive investigations of Site conditions.

F. On request, and to the extent Owner has control over the Site, and schedule permitting, the Owner will provide Bidder general access to the Site to conduct such additional examinations, investigations, explorations, tests, and studies as Bidder deems necessary for preparing and submitting a successful Bid. Owner will not have any obligation to grant such access if doing so is not practical because of existing operations, security or safety concerns, or restraints on Owner's authority regarding the Site. Bidder is responsible for establishing access needed to reach specific selected test sites.

G. Bidder must comply with all applicable Laws and Regulations regarding excavation and location of utilities, obtain all permits, and comply with all terms and conditions established by Owner or by property owners or other entities controlling the Site with respect to schedule, access, existing operations, security, liability insurance, and applicable safety programs.

H. Bidder must fill all holes and clean up and restore the Site to its former condition upon completion of such explorations, investigations, tests, and studies.

5.05 Owner's Safety Program

A. Site visits and work at the Site may be governed by an Owner safety program. If an Owner safety program exists, it will be noted in the Supplementary Conditions.

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5.06 Other Work at the Site

A. Reference is made to Article 8 of the Supplementary Conditions for the identification of the general nature of other work of which Owner is aware (if any) that is to be performed at the Site by Owner or others (such as utilities and other prime contractors) and relates to the Work contemplated by these Bidding Documents. If Owner is party to a written contract for such other work, then on request, Owner will provide to each Bidder access to examine such contracts (other than portions thereof related to price and other confidential matters), if any.

ARTICLE 6—BIDDER'S REPRESENTATIONS AND CERTIFICATIONS

6.01 Express Representations and Certifications in Bid Form, Agreement

A. The Bid Form that each Bidder will submit contains express representations regarding the Bidder's examination of Project documentation, Site visit, and preparation of the Bid, and certifications regarding lack of collusion or fraud in connection with the Bid. Bidder should review these representations and certifications and assure that Bidder can make the representations and certifications in good faith, before executing and submitting its Bid.

B. If Bidder is awarded the Contract, Bidder (as Contractor) will make similar express representations and certifications when it executes the Agreement.

ARTICLE 7—INTERPRETATIONS AND ADDENDA

7.01 Owner on its own initiative may issue Addenda to clarify, correct, supplement, or change the Bidding Documents.

7.02 Bidder shall submit all questions about the meaning or intent of the Bidding Documents to Engineer in writing. Contact information and submittal procedures for such questions are as follows:

David H. Melvin Consulting Engineers
4428 Lafayette Street, Marianna, Florida, 32446
(850) 482-3045 /martivickery@melvineng.com

7.03 Interpretations or clarifications considered necessary by Engineer in response to such questions will be issued by Addenda delivered to all registered plan holders. Questions received less than seven days prior to the date for opening of Bids may not be answered.

7.04 Only responses set forth in an Addendum will be binding. Oral and other interpretations or clarifications will be without legal effect. Responses to questions are not part of the Contract Documents unless set forth in an Addendum that expressly modifies or supplements the Contract Documents.

ARTICLE 8—BID SECURITY

8.01 A Bid must be accompanied by Bid security made payable to Owner in an amount of **5%** percent of Bidder's maximum Bid price (determined by adding the base bid and all alternates) and in the form of a Bid bond issued by a surety meeting the requirements of Paragraph 6.01 of the General Conditions. Such Bid bond will be issued in the form included in the Bidding Documents.

8.02 The Bid security of the apparent Successful Bidder will be retained until Owner awards the contract to such Bidder, and such Bidder has executed the Contract, furnished the required

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Contract security, and met the other conditions of the Notice of Award, whereupon the Bid security will be released. If the Successful Bidder fails to execute and deliver the Contract and furnish the required Contract security within 15 days after the Notice of Award, Owner may consider Bidder to be in default, annul the Notice of Award, and the Bid security of that Bidder will be forfeited, in whole in the case of a penal sum bid bond, and to the extent of Owner's damages in the case of a damages-form bond. Such forfeiture will be Owner's exclusive remedy if Bidder defaults.

8.03 The Bid security of other Bidders that Owner believes to have a reasonable chance of receiving the award may be retained by Owner until the earlier of 7 days after the Effective Date of the Contract or 61 days after the Bid opening, whereupon Bid security furnished by such Bidders will be released.

8.04 Bid security of other Bidders that Owner believes do not have a reasonable chance of receiving the award will be released within 7 days after the Bid opening.

ARTICLE 9—CONTRACT TIMES

9.01 The number of days within which, or the dates by which, the Work is to be (a) substantially completed and (b) ready for final payment, and (c) Milestones (if any) are to be achieved, are set forth in the Agreement.

9.02 Provisions for liquidated damages, if any, for failure to timely attain a Milestone, Substantial Completion, or completion of the Work in readiness for final payment, are set forth in the Agreement.

ARTICLE 10—SUBSTITUTE AND "OR EQUAL" ITEMS

10.01 The Contract for the Work, as awarded, will be on the basis of materials and equipment specified or described in the Bidding Documents, and those "or-equal" or substitute or materials and equipment subsequently approved by Engineer prior to the submittal of Bids and identified by Addendum. No item of material or equipment will be considered by Engineer as an "or-equal" or substitute unless written request for approval has been submitted by Bidder and has been received by Engineer within 10 days of the issuance of the Advertisement for Bids or invitation to Bidders. Each such request must comply with the requirements of Paragraphs 7.05 and 7.06 of the General Conditions, and the review of the request will be governed by the principles in those paragraphs. The burden of proof of the merit of the proposed item is upon Bidder. Engineer's decision of approval or disapproval of a proposed item will be final. If Engineer approves any such proposed item, such approval will be set forth in an Addendum issued to all registered Bidders. Bidders cannot rely upon approvals made in any other manner.

10.02 All prices that Bidder sets forth in its Bid will be based on the presumption that the Contractor will furnish the materials and equipment specified or described in the Bidding Documents, as supplemented by Addenda. Any assumptions regarding the possibility of post-Bid approvals of "or-equal" or substitution requests are made at Bidder's sole risk.

ARTICLE 11—SUBCONTRACTORS, SUPPLIERS, AND OTHERS

11.01 A Bidder must be prepared to retain specific Subcontractors and Suppliers for the performance of the Work if required to do so by the Bidding Documents or in the Specifications. If a prospective

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Bidder objects to retaining any such Subcontractor or Supplier and the concern is not relieved by an Addendum, then the prospective Bidder should refrain from submitting a Bid.

11.02 The apparent Successful Bidder, and any other Bidder so requested, shall within five days after bid opening, submit to Owner a list of the Subcontractors or Suppliers proposed for those portions of the Work for which such identification is required.

11.03 If requested by Owner, such list must be accompanied by an experience statement with pertinent information regarding similar projects and other evidence of qualification for each such Subcontractor or Supplier. If Owner or Engineer, after due investigation, has reasonable objection to any proposed Subcontractor or Supplier, Owner may, before the Notice of Award is given, request apparent Successful Bidder to submit an acceptable substitute, in which case apparent Successful Bidder will submit a substitute, Bidder's Bid price will be increased (or decreased) by the difference in cost occasioned by such substitution, and Owner may consider such price adjustment in evaluating Bids and making the Contract award.

11.04 If apparent Successful Bidder declines to make any such substitution, Owner may award the Contract to the next lowest Bidder that proposes to use acceptable Subcontractors and Suppliers. Declining to make requested substitutions will constitute grounds for forfeiture of the Bid security of any Bidder. Any Subcontractor or Supplier, so listed and against which Owner or Engineer makes no written objection prior to the giving of the Notice of Award will be deemed acceptable to Owner and Engineer subject to subsequent revocation of such acceptance as provided in Paragraph 7.07 of the General Conditions.

ARTICLE 12—PREPARATION OF BID

12.01 The Bid Form is included with the Bidding Documents.

A. All blanks on the Bid Form must be completed in ink and the Bid Form signed in ink. Erasures or alterations must be initialed in ink by the person signing the Bid Form. A Bid price must be indicated for each section, Bid item, alternate, adjustment unit price item, and unit price item listed therein.

B. If the Bid Form expressly indicates that submitting pricing on a specific alternate item is optional, and Bidder elects to not furnish pricing for such optional alternate item, then Bidder may enter the words "No Bid" or "Not Applicable."

12.02 If Bidder has obtained the Bidding Documents as Electronic Documents, then Bidder shall prepare its Bid on a paper copy of the Bid Form printed from the Electronic Documents version of the Bidding Documents. The printed copy of the Bid Form must be clearly legible, printed on 8½ inch by 11-inch paper and as closely identical in appearance to the Electronic Document version of the Bid Form as may be practical. The Owner reserves the right to accept Bid Forms which nominally vary in appearance from the original paper version of the Bid Form, providing that all required information and submittals are included with the Bid.

12.03 A Bid by a corporation must be executed in the corporate name by a corporate officer (whose title must appear under the signature), accompanied by evidence of authority to sign. The corporate address and state of incorporation must be shown.

12.04 A Bid by a partnership must be executed in the partnership name and signed by a partner (whose title must appear under the signature), accompanied by evidence of authority to sign. The official address of the partnership must be shown.

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12.05 A Bid by a limited liability company must be executed in the name of the firm by a member or other authorized person and accompanied by evidence of authority to sign. The state of formation of the firm and the official address of the firm must be shown.

12.06 A Bid by an individual must show the Bidder's name and official address.

12.07 A Bid by a joint venture must be executed by an authorized representative of each joint venturer in the manner indicated on the Bid Form. The joint venture must have been formally established prior to submittal of a Bid, and the official address of the joint venture must be shown.

12.08 All names must be printed in ink below the signatures.

12.09 The Bid must contain an acknowledgment of receipt of all Addenda, the numbers of which must be filled in on the Bid Form.

12.10 Postal and e-mail addresses and telephone number for communications regarding the Bid must be shown.

12.11 The Bid must contain evidence of Bidder's authority to do business in the state where the Project is located, or Bidder must certify in writing that it will obtain such authority within the time for acceptance of Bids and attach such certification to the Bid.

12.12 If Bidder is required to be licensed to submit a Bid or perform the Work in the state where the Project is located, the Bid must contain evidence of Bidder's licensure, or Bidder must certify in writing that it will obtain such licensure within the time for acceptance of Bids and attach such certification to the Bid. Bidder's state contractor license number, if any, must also be shown on the Bid Form.

ARTICLE 13—BASIS OF BID

13.01 Lump Sum

A. Bidders must submit a Bid on a lump sum basis as set forth in the Bid Form.

13.02 Unit Price

A. Bidders must submit a Bid on a unit price basis for each item of Work listed in the unit price section of the Bid Form.

B. The "Bid Price" (sometimes referred to as the extended price) for each unit price Bid item will be the product of the "Estimated Quantity", which Owner or its representative has set forth in the Bid Form, for the item and the corresponding "Bid Unit Price" offered by the Bidder. The total of all unit price Bid items will be the sum of these "Bid Prices"; such total will be used by Owner for Bid comparison purposes. The final quantities and Contract Price will be determined in accordance with Paragraph 13.03 of the General Conditions.

C. Discrepancies between the multiplication of units of Work and unit prices will be resolved in favor of the unit prices. Discrepancies between the indicated sum of any column of figures and the correct sum thereof will be resolved in favor of the correct sum.

13.03 Allowances

A. Allowance amount is for direct costs only, including material, direct labor, and subcontractor cost. Contractor overhead, profit, bonds, insurance, and other general conditions costs associated with the allowance work shall be included in the Base Bid and shall not be added to the allowance amount.

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ARTICLE 14—SUBMITTAL OF BID

14.01 The Bidding Documents include one separate unbound copy of the Bid Form, and, if required, the Bid Bond Form. The unbound copy of the Bid Form is to be completed and submitted with the Bid security and the other documents required to be submitted under the terms of Article 2 of the Bid Form.

14.02 A Bid must be received no later than the date and time prescribed and at the place indicated in the Advertisement or invitation to bid and must be enclosed in a plainly marked package with the Project title, and, if applicable, the designated portion of the Project for which the Bid is submitted, the name and address of Bidder, and must be accompanied by the Bid security and other required documents. If a Bid is sent by mail or other delivery system, the sealed envelope containing the Bid must be enclosed in a separate package plainly marked on the outside with the notation "BID ENCLOSED." A mailed Bid must be addressed to the location designated in the Advertisement.

14.03 Bids received after the date and time prescribed for the opening of bids, or not submitted at the correct location or in the designated manner, will not be accepted and will be returned to the Bidder unopened.

ARTICLE 15—MODIFICATION AND WITHDRAWAL OF BID

15.01 An unopened Bid may be withdrawn by an appropriate document duly executed in the same manner that a Bid must be executed and delivered to the place where Bids are to be submitted prior to the date and time for the opening of Bids. Upon receipt of such notice, the unopened Bid will be returned to the Bidder.

15.02 If a Bidder wishes to modify its Bid prior to Bid opening, Bidder must withdraw its initial Bid in the manner specified in Paragraph 15.01 and submit a new Bid prior to the date and time for the opening of Bids.

15.03 If within 24 hours after Bids are opened any Bidder files a duly signed written notice with Owner and promptly thereafter demonstrates to the reasonable satisfaction of Owner that there was a material and substantial mistake in the preparation of its Bid, the Bidder may withdraw its Bid,

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and the Bid security will be returned. Thereafter, if the Work is rebid, the Bidder will be disqualified from further bidding on the Work.

ARTICLE 16—OPENING OF BIDS

16.01 Bids will be opened at the time and place indicated in the advertisement or invitation to bid and, unless obviously non-responsive, read aloud publicly. An abstract of the amounts of the base Bids and major alternates, if any, will be made available to Bidders after the opening of Bids.

ARTICLE 17—BIDS TO REMAIN SUBJECT TO ACCEPTANCE

17.01 All Bids will remain subject to acceptance for the period of time stated in the Bid Form, but Owner may, in its sole discretion, release any Bid and return the Bid security prior to the end of this period.

ARTICLE 18—EVALUATION OF BIDS AND AWARD OF CONTRACT

18.01 Owner reserves the right to reject any or all Bids, including without limitation, nonconforming, nonresponsive, unbalanced, or conditional Bids. Owner also reserves the right to waive all minor Bid informalities not involving price, time, or changes in the Work.

18.02 Owner will reject the Bid of any Bidder that Owner finds, after reasonable inquiry and evaluation, to not be responsible.

18.03 If Bidder purports to add terms or conditions to its Bid, takes exception to any provision of the Bidding Documents, or attempts to alter the contents of the Contract Documents for purposes of the Bid, whether in the Bid itself or in a separate communication to Owner or Engineer, then Owner will reject the Bid as nonresponsive.

18.04 If Owner awards the contract for the Work, such award will be to the responsible Bidder submitting the lowest responsive Bid.

18.05 Evaluation of Bids

A. In evaluating Bids, Owner will consider whether the Bids comply with the prescribed requirements, and such alternates, unit prices, and other data, as may be requested in the Bid Form or prior to the Notice of Award.

B. For the determination of the apparent low Bidder when unit price bids are submitted, Bids will be compared on the basis of the total of the products of the estimated quantity of each item and unit price Bid for that item, together with any lump sum items.

18.06 In evaluating whether a Bidder is responsible, Owner will consider the qualifications of the Bidder and may consider the qualifications and experience of Subcontractors and Suppliers proposed for

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those portions of the Work for which the identity of Subcontractors and Suppliers must be submitted as provided in the Bidding Documents.

18.07 Owner may conduct such investigations as Owner deems necessary to establish the responsibility, qualifications, and financial ability of Bidders and any proposed Subcontractors or Suppliers.

ARTICLE 19—BONDS AND INSURANCE

19.01 Article 6 of the General Conditions, as may be modified by the Supplementary Conditions, sets forth Owner's requirements as to performance and payment bonds, other required bonds (if any), and insurance. When the Successful Bidder delivers the executed Agreement to Owner, it must be accompanied by required bonds and insurance documentation.

19.02 Article 8, Bid Security, of these Instructions, addresses any requirements for providing bid bonds as part of the bidding process.

ARTICLE 20—SIGNING OF AGREEMENT

20.01 When Owner issues a Notice of Award to the Successful Bidder, it will be accompanied by the unexecuted counterparts of the Agreement along with the other Contract Documents as identified in the Agreement. Within 15 days thereafter, Successful Bidder must execute and deliver the required number of counterparts of the Agreement and any bonds and insurance documentation required to be delivered by the Contract Documents to Owner. Within 10 days thereafter, Owner will deliver one fully executed counterpart of the Agreement to Successful Bidder, together with printed and electronic copies of the Contract Documents as stated in Paragraph 2.02 of the General Conditions.

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C-300
BIDDER'S CHECKLIST

Project Name: Marianna - Project Iralena

The checklist below is provided to ensure that all documents and certifications required as a part of the bidding process have been completed and included in your bid package. This checklist should be completed and included as a part of the bid package submitted.

- ☐ C-300 Bidder's Checklist
- ☐ C-410 - Bid Proposal
- ☐ C-430 - Bid Bond
- ☐ C-440 - Certifications Regarding Equal Employment Opportunity
- ☐ C-451 – Qualifications Statement
- ☐ C-470 - Public Entity Crimes Statemen
- ☐ C-471 - Drug Free Workplace Certification
- ☐ C-472 - Certification Regarding Lobbying
- ☐ C-473 - Certifications Regarding Section 3 and Segregated Facilities
  Section 3 Contract Clause
- ☐ C-474 - Certifications Regarding Labor Standards and Prevailing Wage Requirements
- ☐ C-475 - MBE/WBE Worksheet
- ☐ C-480 - Certification Regarding Debarment
- ☐ Conflict of Interest

This project will be partially funded with Federal funds from the United State Department of Housing and Urban Development (Community Development Block Grant – Economic Development (CDBG-ED) and therefore is subject to the Federal laws and regulations associated with that program. The following sections of the specifications should be thoroughly reviewed and by signature below you are acknowledging that these sections have been reviewed, understood, and all federal and state requirements will be met.

C-111 Advertisement for Bids
C-200 Instructions to Bidders
C-520 Contract Agreement
C-530 Federal Contract Provisions
Appendix II to Part 200, Title 2
CDBG Supplemental Conditions for Construction Contracts
C-800 Supplemental General Conditions of the Construction Contract

In the event the bids submitted by the bidders exceed the amount of funding designated for the project, the Owner may modify the scope of the project and negotiate with the lowest bidder to bring the project within the funding amount allocated.

Signed:_____

Print Name and Title: _____

BID BOND (PENAL SUM FORM)

Bidder	**Surety**
Name: _____	Name: _____
Address *(principal place of business)*:	Address *(principal place of business)*:
_____	_____
_____	_____
Owner	**Bid**
Name: _____	Project *(name and location)*:
Address *(principal place of business)*:	_____
_____	_____
_____	_____
_____	_____
	Bid Due Date:

Bond

Penal Sum:

Date of Bond:

Surety and Bidder, intending to be legally bound hereby, subject to the terms set forth in this Bid Bond, do each cause this Bid Bond to be duly executed by an authorized officer, agent, or representative.

Bidder	Surety
_____	_____
(Full formal name of Bidder)	*(Full formal name of Surety) (corporate seal)*
By: _____	By: _____
(Signature)	*(Signature) (Attach Power of Attorney)*
Name: _____	Name: _____
(Printed or typed)	*(Printed or typed)*
Title: _____	Title: _____
Attest: _____	Attest: _____
(Signature)	*(Signature)*
Name: _____	Name: _____
(Printed or typed)	*(Printed or typed)*
Title:	Title:

Notes: (1) Note: Addresses are to be used for giving any required notice. (2) Provide execution by any additional parties, such as joint venturers, if necessary.

BID FORM FOR CONSTRUCTION CONTRACT

The terms used in this Bid with initial capital letters have the meanings stated in the Instructions to Bidders, the General Conditions, and the Supplementary Conditions.

ARTICLE 1—OWNER AND BIDDER

1.01 This Bid is submitted to:

City of Marianna
City Clerk's Office
2895 Jefferson Street
Marianna, FL 32446

1.02 The undersigned Bidder proposes and agrees, if this Bid is accepted, to enter into an Agreement with Owner in the form included in the Bidding Documents to perform all Work as specified or indicated in the Bidding Documents for the prices and within the times indicated in this Bid and in accordance with the other terms and conditions of the Bidding Documents.

ARTICLE 2—BASIS OF BID – LUMP SUM

TOTAL BID AMOUNT $_____

2.01 The Owner will award the contract based on the contractor's experience, qualifications, and the lowest responsible bid, as determined to be in the Owner's best interest. Evaluation of the lowest bid will include consideration of any additive or deductive alternates selected by the Owner. The Owner reserves the right to negotiate, and value engineer the project with the lowest responsible bidder to ensure alignment with the project budget. Additionally, the Owner reserves the right to reject any or all bids.

2.02 All employees of the bidder, as well as all employees of any subcontractors working on the project, must provide documentation verifying their legal status and eligibility to work in the United States through the E-Verify system.

2.03 The bid price shall include the furnishing a complete and fully operational system constructed in full compliance with all applicable codes and regulations.

2.04 The Owner reserves the right to waive any informality and to award the bid based upon the Owner's determination of best interest and best value. Owner may consider ability to perform, past performance and location of contractors office in selecting contractor.

2.05 Contractor or subcontractors must be properly licensed to perform the various scopes of work. Contractor's experience will be evaluated as part of the bid selection process. The contractor shall be on schedule with other projects currently under contract with the owner and others. Contractor shall furnish and supply all materials, equipment and labor for a complete and operational system including testing.

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Bid Tabulation Detail

Item No.	Description	Total Price
1.	General Requirements	$
2.	Performance and Payment Bonds	$
3.	Building Permit Allowance	$ 15,000.00
4.	Demolition	$
5.	Concrete/Masonry	$
6.	Structural/Metals	$
7.	Wood/Carpentry	$
8.	Thermal/Moisture Protection/Roofing	$
9.	Openings Doors/Windows	$
10.	Finishes/Flooring	$
11.	Specialties	$
12.	Mechanical	$
13.	Plumbing	$
14.	Fire Protection	$
15.	Electrical & Low Voltage	$
16.	Allowances as indicated on Plans excluding finish allowances on Sht. A-2	$ 228,930.00
17.	Contingency Allowance	$ 90,000.00
18.	**Total Bid Price**	**$**

Allowance amount is for direct costs only, including material, direct labor, and subcontractor cost. Contractor overhead, profit, bonds, insurance, and other general conditions costs associated with the allowance work shall be included in the base bid or general requirments and shall not be added to the allowance amount.

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ARTICLE 3—ATTACHMENTS TO THIS BID

3.01 *The following documents are submitted with and made a condition of this Bid:*

A. Bidder will perform the following Work at the indicated unit prices provided in Attachment G.

B. Bidder Required Bid security;

C. List of Proposed Subcontractors;

D. List of Proposed Suppliers;

E. Evidence of authority to do business in the state of the Project; or a written covenant to obtain such authority within the time for acceptance of Bids;

F. Contractor's license number as evidence of Bidder's State Contractor's License or a covenant by Bidder to obtain said license within the time for acceptance of Bids;

G. Required Bidder Qualification Statement with supporting data;

H. Completed Bid Form

I. Bidders Checklist

ARTICLE 4—TIME OF COMPLETION

4.01 Bidder agrees that the Work will be substantially complete within **300 days** and will be completed and ready for final payment within **30 days thereafter** in accordance with Paragraph 15.06 of the General Conditions on or before the dates or within the number of calendar days indicated in the Agreement.

4.02 Bidder accepts the provisions of the Agreement as to liquidated damages in the amount of **$450 per calendar day** beyond the substantial completion or final completion date.

ARTICLE 5—

ARTICLE 6—

6.01

ARTICLE 7—BIDDER'S ACKNOWLEDGEMENTS: ACCEPTANCE PERIOD, INSTRUCTIONS, AND RECEIPT OF ADDENDA

7.01 *Bid Acceptance Period*

A. This Bid will remain subject to acceptance for 60 days after the Bid opening, or for such longer period of time that Bidder may agree to in writing upon request of Owner.

7.02 *Instructions to Bidders*

A. Bidder accepts all of the terms and conditions of the Instructions to Bidders, including without limitation those dealing with the disposition of Bid security.

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7.03 *Receipt of Addenda*

A. Bidder hereby acknowledges receipt of the following Addenda:

Addendum Number	Addendum Date

ARTICLE 8—BIDDER'S REPRESENTATIONS AND CERTIFICATIONS

8.01 *Bidder's Representations*

A. In submitting this Bid, Bidder represents the following:

1. Bidder has examined and carefully studied the Bidding Documents, including Addenda.
2. Bidder has visited the Site, conducted a thorough visual examination of the Site and adjacent areas, and become familiar with the general, local, and Site conditions that may affect cost, progress, and performance of the Work.
3. Bidder is familiar with all Laws and Regulations that may affect cost, progress, and performance of the Work.
4. Bidder has carefully studied the reports of explorations and tests of subsurface conditions at or adjacent to the Site and the drawings of physical conditions relating to existing surface or subsurface structures at the Site that have been identified in the Supplementary Conditions, with respect to the Technical Data in such reports and drawings.
5. Bidder has carefully studied the reports and drawings relating to Hazardous Environmental Conditions, if any, at or adjacent to the Site that have been identified in the Supplementary Conditions, with respect to Technical Data in such reports and drawings.
6. Bidder has considered the information known to Bidder itself; information commonly known to contractors doing business in the locality of the Site; information and observations obtained from visits to the Site; the Bidding Documents; and the Technical Data identified in the Supplementary Conditions or by definition, with respect to the effect of such information, observations, and Technical Data on (a) the cost, progress, and performance of the Work; (b) the means, methods, techniques, sequences, and procedures of construction to be employed by Bidder, if selected as Contractor; and (c) Bidder's (Contractor's) safety precautions and programs.
7. Based on the information and observations referred to in the preceding paragraph, Bidder agrees that no further examinations, investigations, explorations, tests, studies, or data are necessary for the performance of the Work at the Contract Price, within the Contract Times, and in accordance with the other terms and conditions of the Contract.
8. Bidder is aware of the general nature of work to be performed by Owner and others at the Site that relates to the Work as indicated in the Bidding Documents.
9. Bidder has given Engineer written notice of all conflicts, errors, ambiguities, or discrepancies that Bidder has discovered in the Bidding Documents, and of discrepancies

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between Site conditions and the Contract Documents, and the written resolution thereof by Engineer is acceptable to Contractor.

10. The Bidding Documents are generally sufficient to indicate and convey understanding of all terms and conditions for performance and furnishing of the Work.

11. The submission of this Bid constitutes an incontrovertible representation by Bidder that without exception the Bid and all prices in the Bid are premised upon performing and furnishing the Work required by the Bidding Documents.

8.02 *Bidder's Certifications*

A. The Bidder certifies the following:

1. This Bid is genuine and not made in the interest of or on behalf of any undisclosed individual or entity and is not submitted in conformity with any collusive agreement or rules of any group, association, organization, or corporation.

2. Bidder has not directly or indirectly induced or solicited any other Bidder to submit a false or sham Bid.

3. Bidder has not solicited or induced any individual or entity to refrain from bidding.

4. Bidder has not engaged in corrupt, fraudulent, collusive, or coercive practices in competing for the Contract. For the purposes of this Paragraph 8.02.A:

a. Corrupt practice means the offering, giving, receiving, or soliciting of anything of value likely to influence the action of a public official in the bidding process.

b. Fraudulent practice means an intentional misrepresentation of facts made (a) to influence the bidding process to the detriment of Owner, (b) to establish bid prices at artificial non-competitive levels, or (c) to deprive Owner of the benefits of free and open competition.

c. Collusive practice means a scheme or arrangement between two or more Bidders, with or without the knowledge of Owner, a purpose of which is to establish bid prices at artificial, non-competitive levels.

d. Coercive practice means harming or threatening to harm, directly or indirectly, persons or their property to influence their participation in the bidding process or affect the execution of the Contract.

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BIDDER hereby submits this Bid as set forth above:

Bidder:

_____

(typed or printed name of organization)

By: _____

(individual's signature)

Name: _____

(typed or printed)

Title: _____

(typed or printed)

Date: _____

(typed or printed)

If Bidder is a corporation, a partnership, or a joint venture, attach evidence of authority to sign.

Attest: _____

(individual's signature)

Name: _____

(typed or printed)

Title: _____

(typed or printed)

Date: _____

(typed or printed)

Address for giving notices:

_____

_____

Bidder's Contact:

Name: _____

(typed or printed)

Title: _____

(typed or printed)

Phone: _____

Email: _____

Address:

_____

_____

_____

Bidder's Contractor License No.: (if applicable) _____

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ATTACHMENT B
LIST OF PROPOSED SUBCONTRACTORS

SUBCONTRACTOR LISTING

The Bidder has fully investigated each subcontractor listed and has in his files evidence that each subcontractor fully complies with the requirements of these specifications, has engaged successfully in his line of work for a reasonable period of time, that he maintains a fully equipped organization capable, technically and financially, of performing the work required, and that he made similar installations in a satisfactory manner.

Name of Subcontractor	Description of Work

EJCDC® C-410, Bid Form for Construction Contract, Attachment B.
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ATTACHMENT C
LIST OF PROPOSED SUPPLIERS

EQUIPMENT AND MATERIAL LISTING

The Bidder will furnish the following items of equipment and materials:

Name of Manufacturer	Description of Material and Equipment

EJCDC® C-410, Bid Form for Construction Contract, Attachment G.
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BID BOND (PENAL SUM FORM)

Bidder	**Surety**
Name: _____	Name: _____
Address *(principal place of business)*:	Address *(principal place of business)*:
_____	_____
_____	_____
Owner	**Bid**
Name: _____	Project *(name and location)*:
Address *(principal place of business)*:	_____
_____	_____
_____	_____
_____	_____
	Bid Due Date:

Bond

Penal Sum:

Date of Bond:

Surety and Bidder, intending to be legally bound hereby, subject to the terms set forth in this Bid Bond, do each cause this Bid Bond to be duly executed by an authorized officer, agent, or representative.

Bidder	Surety
_____	_____
(Full formal name of Bidder)	*(Full formal name of Surety) (corporate seal)*
By: _____	By: _____
(Signature)	*(Signature) (Attach Power of Attorney)*
Name: _____	Name: _____
(Printed or typed)	*(Printed or typed)*
Title: _____	Title: _____
Attest: _____	Attest: _____
(Signature)	*(Signature)*
Name: _____	Name: _____
(Printed or typed)	*(Printed or typed)*
Title:	Title:

Notes: (1) Note: Addresses are to be used for giving any required notice. (2) Provide execution by any additional parties, such as joint venturers, if necessary.

1. Bidder and Surety, jointly and severally, bind themselves, their heirs, executors, administrators, successors, and assigns to pay to Owner upon default of Bidder the penal sum set forth on the face of this Bond. Payment of the penal sum is the extent of Bidder's and Surety's liability. Recovery of such penal sum under the terms of this Bond will be Owner's sole and exclusive remedy upon default of Bidder.
2. Default of Bidder occurs upon the failure of Bidder to deliver within the time required by the Bidding Documents (or any extension thereof agreed to in writing by Owner) the executed Agreement required by the Bidding Documents and any performance and payment bonds required by the Bidding Documents.
3. This obligation will be null and void if:
   3.1. Owner accepts Bidder's Bid and Bidder delivers within the time required by the Bidding Documents (or any extension thereof agreed to in writing by Owner) the executed Agreement required by the Bidding Documents and any performance and payment bonds required by the Bidding Documents, or
   3.2. All Bids are rejected by Owner, or
   3.3. Owner fails to issue a Notice of Award to Bidder within the time specified in the Bidding Documents (or any extension thereof agreed to in writing by Bidder and, if applicable, consented to by Surety when required by Paragraph 5 hereof).
4. Payment under this Bond will be due and payable upon default of Bidder and within 30 calendar days after receipt by Bidder and Surety of written notice of default from Owner, which notice will be given with reasonable promptness, identifying this Bond and the Project and including a statement of the amount due.
5. Surety waives notice of any and all defenses based on or arising out of any time extension to issue Notice of Award agreed to in writing by Owner and Bidder, provided that the total time for issuing Notice of Award including extensions does not in the aggregate exceed 120 days from the Bid due date without Surety's written consent.
6. No suit or action will be commenced under this Bond prior to 30 calendar days after the notice of default required in Paragraph 4 above is received by Bidder and Surety, and in no case later than one year after the Bid due date.
7. Any suit or action under this Bond will be commenced only in a court of competent jurisdiction located in the state in which the Project is located.
8. Notices required hereunder must be in writing and sent to Bidder and Surety at their respective addresses shown on the face of this Bond. Such notices may be sent by personal delivery, commercial courier, or by United States Postal Service registered or certified mail, return receipt requested, postage pre-paid, and will be deemed to be effective upon receipt by the party concerned.
9. Surety shall cause to be attached to this Bond a current and effective Power of Attorney evidencing the authority of the officer, agent, or representative who executed this Bond on behalf of Surety to execute, seal, and deliver such Bond and bind the Surety thereby.
10. This Bond is intended to conform to all applicable statutory requirements. Any applicable requirement of any applicable statute that has been omitted from this Bond will be deemed to be included herein as if set forth at length. If any provision of this Bond conflicts with any applicable statute, then the provision of said statute governs and the remainder of this Bond that is not in conflict therewith continues in full force and effect.
11. The term "Bid" as used herein includes a Bid, offer, or proposal as applicable.

SECTION C-440

CERTIFICATION BY BIDDER

This certification is required pursuant to Executive Order 11246 (30 F.R. 12319-25). The implementing rules and regulations provide that any bidder or prospective contractor, or any of their proposed subcontractors, shall state as an initial part of the bid or negotiations of the contract whether it has participated in any previous contract or subcontract subject to the equal opportunity clause; and if so, whether it has filed all compliance reports due under applicable instructions.

Where the certification indicates that the bidder has not filed a compliance report due under applicable instructions, such bidder shall be required to submit a compliance report within seven calendar days after bid opening. No contract shall be awarded unless such report is submitted.

NAME AND ADDRESS OF BIDDER (include ZIP Code):

1. Bidder has participated in a previous contract or subcontract subject to the Equal Opportunity Clause. Yes ( ) No ( )

2. Compliance reports were required to be filed in connection with such contract or subcontract. Yes ( ) No ( )

3. Bidder has filed all compliance reports due under applicable instructions, including SF 100. Yes ( ) No ( )

4. Have you ever been or are you being considered for sanction due to violation of Executive Order 112246, as amended? Yes ( ) No ( )

NAME AND TITLE OF SIGNER (Please Type):

_____ _____

(Signature) (Date)

ARTICLE 1—GENERAL INFORMATION

1.01 Provide contact information for the Business:

Legal Name of Business:			
Corporate Office			
Name:		Phone number:	
Title:		Email address:	
Business address of corporate office:			
Local Office			
Name:		Phone number:	
Title:		Email address:	
Business address of local office:			

1.02 Provide information on the Business's organizational structure:

Form of Business:	☐ Sole Proprietorship ☐ Partnership ☐ Corporation		
☐ Limited Liability Company ☐ Joint Venture comprised of the following companies:			
	1.		
	2.		
	3.		
Provide a separate Qualification Statement for each Joint Venturer.			
Date Business was formed:		State in which Business was formed:	
Is this Business authorized to operate in the Project location?	☐ Yes ☐ No ☐ Pending		

1.03 Provide information regarding the Business's officers, partners, and limits of authority.

Name:		Title:	
Authorized to sign contracts: ☐ Yes ☐ No		Limit of Authority:	$
Name:		Title:	
Authorized to sign contracts: ☐ Yes ☐ No		Limit of Authority:	$
Name:		Title:	
Authorized to sign contracts: ☐ Yes ☐ No		Limit of Authority:	$
Name:		Title:	

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ARTICLE 2—LICENSING

2.01 Provide information regarding licensure for Business:

Name of License:			
Licensing Agency:			
License No:		Expiration Date:	
Name of License:			
Licensing Agency:			
License No:		Expiration Date:	

ARTICLE 3—DIVERSE BUSINESS CERTIFICATIONS

3.01 Provide information regarding Business's Diverse Business Certification, if any. Provide evidence of current certification.

Certification	Certifying Agency	Certification Date
☐ Disadvantaged Business Enterprise		
☐ Minority Business Enterprise		
☐ Woman-Owned Business Enterprise		
☐ Small Business Enterprise		
☐ Disabled Business Enterprise		
☐ Veteran-Owned Business Enterprise		
☐ Service-Disabled Veteran-Owned Business		
☐ HUBZone Business (Historically Underutilized) Business		
☐ Other		
☐ None		

ARTICLE 4—SAFETY

4.01 Provide Worker's Compensation Insurance Documentation.

Year	
Company	

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ARTICLE 5—
FINANCIAL

5.01 Provide information regarding the Business's financial stability. Provide the most recent audited financial statement, and if such audited financial statement is not current, also provide the most current financial statement.

Financial Institution:		
Business address:		
Date of Business's most recent financial statement:		☐ Attached
Date of Business's most recent audited financial statement:		☐ Attached
Financial indicators from the most recent financial statement		
Contractor's Current Ratio (Current Assets ÷ Current Liabilities)		
Contractor's Quick Ratio ((Cash and Cash Equivalents + Accounts Receivable + Short Term Investments) ÷ Current Liabilities)		

ARTICLE 6—SURETY INFORMATION

6.01 Provide information regarding the surety company that will issue required bonds on behalf of the Business, including but not limited to performance and payment bonds.

Surety Name:			
Surety is a corporation organized and existing under the laws of the state of:			
Is surety authorized to provide surety bonds in the Project location?	☐ Yes ☐ No		
Is surety listed in "Companies Holding Certificates of Authority as Acceptable Sureties on Federal Bonds and as Acceptable Reinsuring Companies" published in Department Circular 570 (as amended) by the Bureau of the Fiscal Service, U.S. Department of the Treasury? ☐ Yes ☐ No			
Mailing Address (principal place of business):			
Physical Address (principal place of business):			
Phone (main):		Phone (claims):	

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ARTICLE 7—INSURANCE

7.01 Provide information regarding Business's insurance company(s), including but not limited to its Commercial General Liability carrier. Provide information for each provider.

Name of insurance provider, and type of policy (CLE, auto, etc.):			
Insurance Provider		Type of Policy (Coverage Provided)	
Are providers licensed or authorized to issue policies in the Project location?			☐ Yes ☐ No
Does provider have an A.M. Best Rating of A-VII or better?			☐ Yes ☐ No
Mailing Address (principal place of business):			
Physical Address (principal place of business):			
Phone (main):		Phone (claims):	

ARTICLE 8—CONSTRUCTION EXPERIENCE

8.01 Provide information that will identify the overall size and capacity of the Business.

Average number of current full-time employees:	
Estimate of revenue for the current year:	
Estimate of revenue for the previous year:	

8.02 Provide information regarding the Business's previous contracting experience.

Years of experience with projects like the proposed project:				
As a general contractor:		As a joint venturer:		
Has Business, or a predecessor in interest, or an affiliate identified in Paragraph 1.03:				
Been disqualified as a bidder by any local, state, or federal agency within the last 5 years? ☐ Yes ☐ No				
Been barred from contracting by any local, state, or federal agency within the last 5 years? ☐ Yes ☐ No				
Been released from a bid in the past 5 years? ☐ Yes ☐ No				
Defaulted on a project or failed to complete any contract awarded to it? ☐ Yes ☐ No				
Refused to construct or refused to provide materials defined in the contract documents or in a change order? ☐ Yes ☐ No				

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Been a party to any currently pending litigation or arbitration? ☐ Yes ☐ No
Provide full details in a separate attachment if the response to any of these questions is Yes.

8.03 List all projects currently under contract in Schedule A and provide indicated information.

8.04 List a minimum of three and a maximum of six projects completed in the last 5 years in Schedule B and provide indicated information to demonstrate the Business's experience with projects similar in type and cost of construction.

8.05 In Schedule C, provide information on key individuals whom Business intends to assign to the Project. Provide resumes for those individuals included in Schedule C. Key individuals include the Project Manager, Project Superintendent, Quality Manager, and Safety Manager. Resumes may be provided for Business's key leaders as well.

ARTICLE 9—REQUIRED ATTACHMENTS

9.01 Provide the following information with the Statement of Qualifications:

A. If Business is a Joint Venture, separate Qualifications Statements for each Joint Venturer, as required in Paragraph 1.02.

B. Diverse Business Certifications if required by Paragraph 3.01.

C. Certification of Business's safety performance if required by Paragraph 4.02.

D. Financial statements as required by Paragraph 5.01.

E. Attachments providing additional information as required by Paragraph 8.02.

F. Schedule A (Current Projects) as required by Paragraph 8.03.

G. Schedule B (Previous Experience with Similar Projects) as required by Paragraph 8.04.

H. Schedule C (Key Individuals) and resumes for the key individuals listed, as required by Paragraph 8.05.

I. Additional items as pertinent.

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This Statement of Qualifications is offered by:

Business: _____
(typed or printed name of organization)

By: _____
(individual's signature)

Name: _____
(typed or printed)

Title: _____
(typed or printed)

Date: _____
(date signed)

(If Business is a corporation, a partnership, or a joint venture, attach evidence of authority to sign.)

Attest: _____
(individual's signature)

Name: _____
(typed or printed)

Title: _____
(typed or printed)

Address for giving notices:

_____

_____

_____

Designated Representative:

Name: _____
(typed or printed)

Title: _____
(typed or printed)

Address:

_____

_____

_____

Phone: _____

Email: _____

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Schedule A—Current Projects

Name of Organization				
Project Owner		Project Name		
General Description of Project				
Project Cost		Date Project		
Key Project Personnel	Project Manager	Project Superintendent	Safety Manager	Quality Control Manager
Name				

Reference Contact Information (listing names indicates approval to contacting the names individuals as a reference)

	Name	Title/Position	Organization	Telephone	Email
Owner					
Designer					
Construction Manager					

Project Owner		Project Name		
General Description of Project				
Project Cost		Date Project		
Key Project Personnel	Project Manager	Project Superintendent	Safety Manager	Quality Control Manager
Name				

Reference Contact Information (listing names indicates approval to contacting the names individuals as a reference)

	Name	Title/Position	Organization	Telephone	Email
Owner					
Designer					
Construction Manager					

Project Owner		Project Name		
General Description of Project				
Project Cost		Date Project		
Key Project Personnel	Project Manager	Project Superintendent	Safety Manager	Quality Control Manager
Name				

Reference Contact Information (listing names indicates approval to contacting the names individuals as a reference)

	Name	Title/Position	Organization	Telephone	Email
Owner					
Designer					
Construction Manager					

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Schedule B—Previous Experience with Similar Projects

Name of Organization				
Project Owner		Project Name		
General Description of Project				
Project Cost		Date Project		
Key Project Personnel	Project Manager	Project Superintendent	Safety Manager	Quality Control Manager
Name				

Reference Contact Information (listing names indicates approval to contacting the names individuals as a reference)

	Name	Title/Position	Organization	Telephone	Email
Owner					
Designer					
Construction Manager					

Project Owner		Project Name		
General Description of Project				
Project Cost		Date Project		
Key Project Personnel	Project Manager	Project Superintendent	Safety Manager	Quality Control Manager
Name				

Reference Contact Information (listing names indicates approval to contacting the names individuals as a reference)

	Name	Title/Position	Organization	Telephone	Email
Owner					
Designer					
Construction Manager					

Project Owner		Project Name		
General Description of Project				
Project Cost		Date Project		
Key Project Personnel	Project Manager	Project Superintendent	Safety Manager	Quality Control Manager
Name				

Reference Contact Information (listing names indicates approval to contacting the names individuals as a reference)

	Name	Title/Position	Organization	Telephone	Email
Owner					
Designer					
Construction Manager					

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Schedule B—Previous Experience with Similar Projects

Name of Organization				
Project Owner		Project Name		
General Description of Project				
Project Cost		Date Project		
Key Project Personnel	Project Manager	Project Superintendent	Safety Manager	Quality Control Manager
Name				

Reference Contact Information (listing names indicates approval to contacting the names individuals as a reference)

	Name	Title/Position	Organization	Telephone	Email
Owner					
Designer					
Construction Manager					

Project Owner		Project Name		
General Description of Project				
Project Cost		Date Project		
Key Project Personnel	Project Manager	Project Superintendent	Safety Manager	Quality Control Manager
Name				

Reference Contact Information (listing names indicates approval to contacting the names individuals as a reference)

	Name	Title/Position	Organization	Telephone	Email
Owner					
Designer					
Construction Manager					

Project Owner		Project Name		
General Description of Project				
Project Cost		Date Project		
Key Project Personnel	Project Manager	Project Superintendent	Safety Manager	Quality Control Manager
Name				

Reference Contact Information (listing names indicates approval to contacting the names individuals as a reference)

	Name	Title/Position	Organization	Telephone	Email
Owner					
Designer					
Construction Manager					

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Schedule C—Key Individuals

Project Manager			
Name of individual			
Years of experience as project manager			
Years of experience with this organization			
Number of similar projects as project manager			
Number of similar projects in other positions			
Current Project Assignments			
Name of assignment		Percent of time used for this project	Estimated project completion date
Reference Contact Information (listing names indicates approval to contact named individuals as a reference)			
Name		Name	
Title/Position		Title/Position	
Organization		Organization	
Telephone		Telephone	
Email		Email	
Project		Project	
Candidate's role on project		Candidate's role on project	
Project Superintendent			
Name of individual			
Years of experience as project superintendent			
Years of experience with this organization			
Number of similar projects as project superintendent			
Number of similar projects in other positions			
Current Project Assignments			
Name of assignment		Percent of time used for this project	Estimated project completion date
Reference Contact Information (listing names indicates approval to contact named individuals as a reference)			
Name		Name	
Title/Position		Title/Position	
Organization		Organization	
Telephone		Telephone	
Email		Email	
Project		Project	
Candidate's role on project		Candidate's role on project	

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Safety Manager			
Name of individual			
Years of experience as project manager			
Years of experience with this organization			
Number of similar projects as project manager			
Number of similar projects in other positions			
Current Project Assignments			
Name of assignment		Percent of time used for this project	Estimated project completion date
Reference Contact Information (listing names indicates approval to contact named individuals as a reference)			
Name		Name	
Title/Position		Title/Position	
Organization		Organization	
Telephone		Telephone	
Email		Email	
Project		Project	
Candidate's role on project		Candidate's role on project	
Quality Control Manager			
Name of individual			
Years of experience as project superintendent			
Years of experience with this organization			
Number of similar projects as project superintendent			
Number of similar projects in other positions			
Current Project Assignments			
Name of assignment		Percent of time used for this project	Estimated project completion date
Reference Contact Information (listing names indicates approval to contact named individuals as a reference)			
Name		Name	
Title/Position		Title/Position	
Organization		Organization	
Telephone		Telephone	
Email		Email	
Project		Project	
Candidate's role on project		Candidate's role on project	

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C-470

SWORN STATEMENT UNDER FLORIDA STATUTE SECTION 287.133 (3) (A) ON PUBLIC ENTITY CRIMES

THIS FORM MUST BE SIGNED IN THE PRESENCE OF A NOTARY PUBLIC OR OTHER OFFICER AUTHORIZED TO ADMINISTER OATHS.

1. This sworn statement is submitted with Bid, Proposal, or Contract for _____.
2. This sworn statement is submitted by (entity),_____,

   Whose business address is, _____, and (if applicable) Federal Employer Identification Number (FEIN) is _____ (if the entity has no FEIN, include the Social Security Number of the individual signing this sworn statement).
3. My name is _____and my relationship to the entity named above is _____(title).
4. I understand that a "public entity crime" as defined in paragraph 287.133(1) (g) Florida Statute, means a violation of any state or federal law by a person with respect to and directly related to the transaction of business with any public entity or with an agency or political subdivision of any other state or with the United States including, but not limited to , any bid or contract for goods or services to be provided to any public entity or any agency or public subdivision of any other state or of the United States and involved antitrust, fraud, theft, bribery, collusion, racketeering, conspiracy or material misrepresentation.
5. I understand that "convicted" or "convicted" as defined in paragraph 287.133 (1) (b), Florida Statutes, means a finding of guilt or a conviction of a public entity crime with or without an adjudication of guilt, in any federal or state trial court of records relating to charges brought by indictment or information after July 1, 1989, as a result of a jury verdict, non-jury trial, or entry of a plea of guilty or nolo contendere.
6. I understand that an "affiliate" as defined in Paragraph 287.133(1) (a), Florida Statutes, means:
   a. A predecessor or successor of a person convicted of a public entity crime; or
   b. An entity under the control of any natural person who is active in the management of the entity and who has been convicted of a public entity crime. The term "affiliate" includes those officers, directors, executives, partners, shareholders, employees, members, and agents who are active in the management of an affiliate. The ownership by one of shares constituting a controlling income among persons when not for fair interest in another person, or a pooling of equipment or income among persons when not for fair market value under a length agreement, shall be a prima facie case that one person controls another person. A person who knowingly convicted of a public entity crime, in Florida during the preceding 36 months shall be considered an affiliate.
7. I understand that a "person" as defined in paragraph 287.133 (1) (e), Florida Statutes, means any natural person or entity organized under the laws of the state or of the United States with the legal power to enter into a binding contract provision of goods or services let by a public entity, or which otherwise transacts or applies to transact business with a public entity. The term "person" includes those officers, directors, executives, partners, shareholders, employees, members, and agents who are active in management of an entity.

8. Based on information and belief, the statement which I have marked below is true in relation to the entity submitting this sworn statement. (Please indicate which statement applies)

☐ Neither the entity submitting this sworn statement, nor any officers, directors, executive, partners, shareholders, employees, member, or agents who are active in management of the entity, nor affiliate of the entity have been charged with and convicted of a public entity crime subsequent to July 1, 1989.

☐ The entity submitting this sworn statement, or one or more of the officers, directors, executives, partners, shareholders, employees, members, or agents who are active in management of the entity, or an affiliate of the entity has been charged with and convicted of a public entity crime subsequent to July 1, 1989. (Please attach a copy of the final order)

☐ The person or affiliate was placed on the convicted BIDDER list. There has been a subsequent proceeding before a hearing officer of the State of Florida, Division of Administrative Hearings. The final order entered by the hearing officer determined that it was in public interest to remove the person or affiliate from the convicted BIDDER list. (Please attach a copy of the final order)

☐ The person or affiliate has not been placed on the convicted BIDDER list. (Please describe any action taken by, or pending with, the department of General Services)

I understand that the submission of this form to the contracting officer for the Public Entity identified in paragraph 4 above is for that Public Entity only, and that this form is valid through December 31 of the calendar year in which it is filed. I also understand that I am required to inform the Public Entity prior to entering a contract in excess of the threshold amount provided in Section 287.017, Florida Statutes, for category two of any change in the information contained in this form.

_____ _____

Signature Date

STATE OF FLORIDA

COUNTY OF: _____

PERSONALLY APPEARED BEFORE ME, the undersigned authority, who, after first being sworn by me, affixed his/her signature at the space provided above on this day of _____, 20____, and is personally known to me, or has provided _____ as identification.

_____

Notary Public

My Commission expires: _____

DRUG FREE WORKPLACE CERTIFICATION
(This form must be completed and attached to proposal)

Preference shall be given to businesses with drug-free workplace programs. Pursuant to Section 287.087, Florida Statutes, whenever two or more bids which are equal with respect price, quality, and service are received by the state or by any political subdivision for the procurement of commodities or contractual services, a response received from a business that certified that it has implemented a drug-free work place program shall be given preference in the award process. Established procedures for processing tie responses will be followed in none of the tied providers has a drug-free workplace program. In order to have a drug-free workplace program, a business shall:

1. Publish a statement notifying employees that the unlawful manufacture, distribution, dispensing, possession or use of a controlled substance is prohibited in the workplace specifying the actions that will be taken against employees for violations of such prohibition.

2. Inform employees about the dangers of drug abuse in the workplace, the business's policy of maintaining a drug-free work place, available drug counseling, rehabilitation providing employee assistance programs, and the penalties that may be imposed upon employees for drug abuse violations.

3. Give each employee engaged in providing the commodities of contractual services that are under bid a copy of the statement specified in paragraph #1.

4. In the statement specified in paragraph #1, notify the employees that, as a condition of working on the commodities or contractual services that are under proposal, the employee will abide by the terms of the statement and will notify the employer of any conviction of or pleas of guilty or no contest to, and violation of Chapter 893, Florida Statutes, or of any controlled substance law of the United States or any state, for a violation occurring in the work place no later than five (5) days after such conviction.

5. Impose a sanction on any employee who is convicted or require the satisfactory participation in a drug abuse assistance or rehabilitation program if such is available in the employee's community.

6. Make a good faith effort to continue to maintain a drug-free workplace through implementation of this section.

As the person authorized to sign this statement, I certify that this firm complies fully with the above requirements.

Company Name	**Authorized Signature**
Federal I.D. Number or SSN	**Printed Name**

Section C-472
44 C.F.R. APPENDIX A, PART 18
CERTIFICATION REGARDING LOBBYING

Certification for Contracts, Grants, Loans, and Cooperative Agreements (To be submitted with each bid or offer exceeding $100,000).

The undersigned certifies, to the best of his or her knowledge, that:

1. No Federal appropriated funds have been paid or will be paid, by or on behalf of the undersigned, to any person for influencing or attempting to influence an officer or employee of an agency, a Member of Congress, an officer or employee of Congress, or an employee of a Member of Congress in connection with the awarding of any Federal contract, the making of any Federal grant, the making of any Federal loan, the entering into of any cooperative agreement, and the extension, continuation, renewal, amendment, or modification of any Federal contract, grant, loan, or cooperative agreement.

2. If any funds other than Federal appropriated funds have been paid or will be paid to any person for influencing or attempting to influence an officer or employee of any agency, a Member of Congress, an officer or employee of Congress, or an employee of a Member of Congress in connection with this Federal contract, grant, loan, or cooperative agreement, the undersigned shall complete and submit Standard Form LLL, "Disclosure Form to Report Lobbying," in accordance with its instructions.

3. The undersigned shall require that the language of this certification be included in the award documents for all subawards at all tiers (including subcontracts, subgrants, and contracts under grants, loans, and cooperative agreements) and that all subrecipients shall certify and disclose accordingly.

This certification is a material representation of fact upon which reliance was placed when this transaction was made or entered into. Submission of this certification is a prerequisite for making or entering into this transaction imposed by 31, U.S.C. § 1352 (as amended by the Lobbying Disclosure Act of 1995). Any person who fails to file the required certification shall be subject to a civil penalty of not less than $10,000 and not more than $100,000 for each such failure.

The Contractor_certifies or affirms the truthfulness and accuracy of each statement of its certification and disclosure, if any. In addition, the Contractor understands and agrees that the provisions of 31 U.S.C. § 3801 et seq., apply to this certification and disclosure, if any.

_____
Signature of Contractor's Authorized Official

_____
Name and Title of Contractor's Authorized Official

_____
Date

C-473

CERTIFICATION OF BIDDER REGARDING SECTION 3 AND SEGREGATED FACILITIES

_____	_____
Name of Prime Contractor	Project Name and Number

The undersigned hereby certifies that:

I agree to comply with all applicable requirements of the Section 3 of the Housing and Urban Development Act of 1968 (24 CFR Part 75). Best efforts must be made to extend Section 3 opportunities to verified Section 3 residents and business concerns to meet these minimum numeric goals:

1. Twenty-five percent (25%) of the total hours on a Section 3 project must be worked by Section 3 workers; and
2. Five percent (5%) of the total hours on a Section 3 project must be worked by Targeted Section 3 workers.

Preference for Contracting with Section 3 Business Concerns

The Town of Malone is required by HUD Regulation 24 CFR Part 75 to make best efforts to contract with businesses that direct economic opportunities to Section 3 workers. As part of its qualitative efforts, the Town of Malone has elected to institute a preference which stipulates that if two or more bids are equal in price then the award preference will be given to the bidder with the highest number of qualified Section 3 subcontractors and/or workers.

Programmatic Responsibilities

Contractors and/or Subcontractors are expected to meet the minimum goals listed above, to the greatest extent feasible. All efforts to utilize Section 3 businesses and workers should be documented, and this Section 3 Project Plan should be submitted for all relevant project bids.

No segregated facilities will be maintained.

_____

Name and Title of Signer:

_____	_____
Signature	Date

CONTRACTOR

Section 3 Plan Format

_____ agrees to implement the following specific affirmative action steps directed at increasing the utilization of lower income residents and businesses with the City/County of _____.

A. To ascertain from the locality's CDBG program official the exact boundaries of the Section 3 covered project area and where advantageous, seek the assistance of local officials in preparing and implementing the affirmative action plan.

B. To attempt to recruit from within the County/City the necessary number of lower income residents through: Local advertising media, signs placed at the proposed site for the project, and community organizations and public or private institutions operating within or serving the project area such as Service Employment and Redevelopment (SER), Opportunities Industrialization Center (OIC), Urban League, Concentrated Employment Program, Hometown Plan or the U.S. Employment Service.

C. To maintain a list of all lower income residents who have applied either on their own or on referral from any source, and to employ such persons, if otherwise eligible and if a vacancy exists.

D. To insert this Section 3 plan in all bid documents, and to require all bidders on subcontracts to submit a Section 3 affirmative action plan including utilization goals and the specific steps planned to accomplish these goals.

E. To ensure this Section 3 plan in all bid documents, and to require all bidders on subcontracts to submit a Section 3 affirmative action plan including utilization goals and the specific steps planned to accomplish these goals.

F. To formally contact unions, subcontractors, and trade associations to secure their cooperation for this program.

G. To ensure that all appropriate project area business concerns are notified of pending sub contractual opportunities.

H. To maintain records, including copies of correspondence, memoranda, etc., which document that all the above affirmative action steps have been taken.

I. To appoint or recruit an executive official of the company or agency as Equal Opportunity Officer to coordinate the implementation of this Section 3 plan.

J. To list on Form A, information related to subcontracts to be awarded.

K. To list on Form B, all projected workforce needs for all phases of this project by occupation, trade, skill level, and number of positions.

As officers and representatives of _____.
(Name of Contractor)

We, the undersigned, have read and fully agree to this Affirmative Action Plan, and become a party to the full implementation of this program.

_____
Signature

_____ _____
Title Date

_____
Signature

_____ _____
Title Date

FORM A- PROPOSED SUBCONTRACTORS BREAKDOWN

FOR THE PERIOD COVERING _____, 20___ THROUGH _____, 20___
(DURATION OF THE CDBG-ASSISTED PROJECT)

Check the box that applies and complete the table if applicable:

- ☐ This project WILL NOT utilize subcontractors.
- ☐ This project MAY utilize the following subcontractors:

No.	Sect3 Bus.	Subcontractor Name	Subcontractor Address and Phone Number	Trade	Subcontract Amount
1					
2					
3					
4					
5					
6					
7					
8					
9					
10					
11					
12					
13					
14					
15					

* The Project Area is coextensive with the City/County of _____'s boundaries.

_____
Company

_____ _____
Project Name Project Number

_____ _____
EEO Officer (Signature) Date

FORM B – LIST OF PERMANENT EMPLOYEES

This form is required for all Section 3-triggered projects and must be submitted with bid or application for funding and again with the final Section 3 compliance report.

Project Name	Contract Execution Date	Construction Start Date	Today's Date

Please list all current permanent employees (both full and part-time) employed by your company (or local/regional office) as of the signature date on Certification Form, as well as employees of all subcontractors working on this project (if applicable). Use additional sheets as necessary. A computer-generated employee registry can be provided in lieu of this form if it includes the worker's name, employer and job category and indicates Section 3/targeted Section 3 status.

No.	Name of Worker	Employer	Job Category/Trade	Section 3 Worker (Y/N)	Targeted Section 3 Worker (Y/N)
1					
2					
3					
4					
5					
6					
7					
8					
9					
10					
11					
12					
13					
14					
15					

Please note that your business may be eligible for Section 3 Business certification if at least 75% of your labor hours performed on all contracts over the past three-month period were performed by employees who meet one of the following categories below:

- The worker lives within one mile of the Section 3 project (or, if fewer than 5,000 people live within one mile of the Section 3 project, within a circle centered on the Section 3 project that is sufficient to encompass a population of 5,000 people according to the most recent U.S. Census);
- The worker is a HUD YouthBuild participant; or
- The worker's income for the previous or annualized calendar year is below 80% of the current area median income for the area in which the worker resides. (Use the worker's annual gross income based on AMI for a single-person household.) HUD income limits can be found at https://www.huduser.gov/portal/datasets/il.html.)

C-474
Certification Regarding Labor Standards and Prevailing Wage

TO (*Appropriate Recipient)*: DATE:

c/o PROJECT NUMBER *(If any):*

PROJECT NAME:

1. The undersigned, having executed a contract with _____ for the construction of the above-identified project, acknowledges that:

   a) The Labor Standards provisions are included in the aforesaid contract;

   b) Correction of any infractions of the aforesaid conditions, including infractions by any of his subcontractors and any lower tier subcontractors, is his responsibility;

2. He certifies that:

   a) Neither he nor any firm, partnership or association in which he has substantial interest is designated as an ineligible contractor by the Comptroller General of the United States pursuant to Section 5.6(b) of the Regulations of the Secretary of Labor, Part 5 (*29 CFR, Part 5*) or pursuant to Section 3(a) of the Davis-Bacon Act, as amended *(40 U.S.C. 276a-2(a)).*

   b) No part of the aforementioned contract has been or will be subcontracted to any subcontractor if such subcontractor or any firm, corporation, partnership or association in which such subcontractor has a substantial interest is designated as an ineligible contractor pursuant to any of the aforementioned regulatory or statutory provisions.

3. He agrees to obtain and forward to the aforementioned recipient within ten days after the execution of any subcontract, including those executed by his subcontractors and any lower tier subcontractors, a Subcontractor's Certification Concerning Labor Standards and Prevailing Wage Requirements executed by the subcontractor.

4. He certifies that:

   a) The legal name and the business address of the undersigned are:

   b) The undersigned is:

   (1) A single proprietorship (3) A corporation organized in the State of

   (2) A partnership (4) Other organization (*Describe*)

   c) The name, title and address of the owner, partners or officers of the undersigned are:

Name	Title	Address
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____

d) The names and addresses of all other persons , both natural and corporate, having a substantial interest in the undersigned, and the nature of the interest are (*if none, so state*):

Name	Title	Address
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____

e) The names, addresses and trade classifications of all other building construction contractors in which the undersigned has a substantial interest are (*if none, so state*):

Name	Title	Address
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____

_____
(Contractor)

Date _____ By_____

WARNING

U.S. Criminal Code, Section 1010, Title 18, U.S.C., provides in part: "Whoever, …. Makes, passes, utters, or publishes any statement, knowing the same to be false …. Shall be fined not more than $5,000 or imprisoned not more than two years, or both.

"General Decision Number: FL20260017 01/02/2026

Superseded General Decision Number: FL20250017

State: Florida

Construction Type: Building

County: Jackson County in Florida.

BUILDING CONSTRUCTION PROJECTS (does not include single family homes or apartments up to and including 4 stories).

Modification Number	Publication Date
0	01/02/2026

ENGI0653-010 10/01/2023

	Rates	Fringes
OPERATOR: Crane		
100 Tons & Over (Conventional & Hydraulic) & Tower Cranes	$ 32.75	14.55
Under 100 Tons	$ 30.25	14.55

Cranes with 350 feet or more boom and/or 400 ton capacity - additional $1.10 per hour.

Cranes with 500 feet boom and/or 600 ton capacity - additional $1.45 per hour.

IRON0798-007 07/01/2025

	Rates	Fringes
IRONWORKER, STRUCTURAL AND REINFORCING	$ 32.00	18.77

SUFL2009-054 05/22/2009

	Rates	Fringes
CARPENTER	$ 12.29	0.27
CEMENT MASON/CONCRETE FINISHER	$ 9.50	0.00
ELECTRICIAN	$ 14.67	0.00
LABORER: Common or General	$ 7.75	0.00
LABORER: Pipelayer	$ 11.42	1.95
OPERATOR: Backhoe/Excavator	$ 12.43	0.00
OPERATOR: Paver (Asphalt, Aggregate, and Concrete)	$ 9.58	0.00
PAINTER: Brush, Roller and Spray	$ 10.10	0.00
PLASTERER	$ 15.90	0.00

PLUMBER.....$ 10.48 2.06

ROOFER: Built Up,
Composition, Hot Tar and
Single Ply.....$ 12.00 0.00

SHEET METAL WORKER, Includes
HVAC Duct Installation.....$ 11.72 2.19

TRUCK DRIVER, Includes Dump
and 10 Yard Haul Away.....$ 8.00 0.15

WELDERS - Receive rate prescribed for craft performing operation to which welding is incidental.

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Note: Executive Order (EO) 13706, Establishing Paid Sick Leave for Federal Contractors applies to all contracts subject to the Davis-Bacon Act for which the contract is awarded (and any solicitation was issued) on or after January 1, 2017. If this contract is covered by the EO, the contractor must provide employees with 1 hour of paid sick leave for every 30 hours they work, up to 56 hours of paid sick leave each year. Employees must be permitted to use paid sick leave for their own illness, injury or other health-related needs, including preventive care; to assist a family member (or person who is like family to the employee) who is ill, injured, or has other health-related needs, including preventive care; or for reasons resulting from, or to assist a family member (or person who is like family to the employee) who is a victim of, domestic violence, sexual assault, or stalking. Additional information on contractor requirements and worker protections under the EO is available at https://www.dol.gov/agencies/whd/government-contracts.

Note: Executive Order 13658 generally applies to contracts subject to the Davis-Bacon Act that were awarded on or between January 1, 2015 and January 29, 2022, and that have not been renewed or extended on or after January 30, 2022. Executive Order 13658 does not apply to contracts subject only to the Davis-Bacon Related Acts regardless of when they were awarded. If a contract is subject to Executive Order 13658, the contractor must pay all covered workers at least $13.30 per hour (or the applicable wage rate listed on this wage determination, if it is higher) for all hours spent performing on the contract in 2025. The applicable Executive Order minimum wage rate will be adjusted annually. Additional information on contractor requirements and worker protections under Executive Order 13658 is available at www.dol.gov/whd/govcontracts.

Unlisted classifications needed for work not included within the scope of the classifications listed may be added after award only as provided in the labor standards contract clauses (29CFR 5.5 (a) (1) (iii)).

The body of each wage determination lists the classifications and wage rates that have been found to be prevailing for the type(s) of construction and geographic area covered by the wage

determination. The classifications are listed in alphabetical order under rate identifiers indicating whether the particular rate is a union rate (current union negotiated rate), a survey rate, a weighted union average rate, a state adopted rate, or a supplemental classification rate.

Union Rate Identifiers

A four-letter identifier beginning with characters other than ""SU"", ""UAVG"", ?SA?, or ?SC? denotes that a union rate was prevailing for that classification in the survey. Example: PLUM0198-005 07/01/2024. PLUM is an identifier of the union whose collectively bargained rate prevailed in the survey for this classification, which in this example would be Plumbers. 0198 indicates the local union number or district council number where applicable, i.e., Plumbers Local 0198. The next number, 005 in the example, is an internal number used in processing the wage determination. The date, 07/01/2024 in the example, is the effective date of the most current negotiated rate.

Union prevailing wage rates are updated to reflect all changes over time that are reported to WHD in the rates in the collective bargaining agreement (CBA) governing the classification.

Union Average Rate Identifiers

The UAVG identifier indicates that no single rate prevailed for those classifications, but that 100% of the data reported for the classifications reflected union rates. EXAMPLE: UAVG-OH-0010 01/01/2024. UAVG indicates that the rate is a weighted union average rate. OH indicates the State of Ohio. The next number, 0010 in the example, is an internal number used in producing the wage determination. The date, 01/01/2024 in the example, indicates the date the wage determination was updated to reflect the most current union average rate.

A UAVG rate will be updated once a year, usually in January, to reflect a weighted average of the current rates in the collective bargaining agreements on which the rate is based.

Survey Rate Identifiers

The ""SU"" identifier indicates that either a single non-union rate prevailed (as defined in 29 CFR 1.2) for this classification in the survey or that the rate was derived by computing a weighted average rate based on all the rates reported in the survey for that classification. As a weighted average rate includes all rates reported in the survey, it may include both union and non-union rates. Example: SUFL2022-007 6/27/2024. SU indicates the rate is a single non-union prevailing rate or a weighted average of survey data for that classification. FL indicates the State of Florida. 2022 is the year of the survey on which these classifications and rates are based. The next number, 007 in the example, is an internal number used in producing the wage determination. The date, 6/27/2024 in the example, indicates the survey completion date for the classifications and rates under that identifier.

?SU? wage rates typically remain in effect until a new survey is conducted. However, the Wage and Hour Division (WHD) has the discretion to update such rates under 29 CFR 1.6(c)(1).

State Adopted Rate Identifiers

The ""SA"" identifier indicates that the classifications and prevailing wage rates set by a state (or local) government were adopted under 29 C.F.R 1.3(g)-(h). Example: SAME2023-007 01/03/2024. SA reflects that the rates are state adopted. ME refers to the State of Maine. 2023 is the year during which the state completed the survey on which the listed classifications and rates are based. The next number, 007 in the example, is an internal number used in producing the wage determination. The date, 01/03/2024 in the example, reflects the date on which the classifications and rates under the ?SA? identifier took effect under state law in the state from which the rates were adopted.

WAGE DETERMINATION APPEALS PROCESS

1) Has there been an initial decision in the matter? This can be:

a) a survey underlying a wage determination
b) an existing published wage determination
c) an initial WHD letter setting forth a position on a wage determination matter
d) an initial conformance (additional classification and rate) determination

On survey related matters, initial contact, including requests for summaries of surveys, should be directed to the WHD Branch of Wage Surveys. Requests can be submitted via email to davisbaconinfo@dol.gov or by mail to:

Branch of Wage Surveys
Wage and Hour Division
U.S. Department of Labor
200 Constitution Avenue, N.W.
Washington, DC 20210

Regarding any other wage determination matter such as conformance decisions, requests for initial decisions should be directed to the WHD Branch of Construction Wage Determinations. Requests can be submitted via email to BCWD-Office@dol.gov or by mail to:

Branch of Construction Wage Determinations
Wage and Hour Division
U.S. Department of Labor
200 Constitution Avenue, N.W.
Washington, DC 20210

2) If an initial decision has been issued, then any interested party (those affected by the action) that disagrees with the decision can request review and reconsideration from the Wage and Hour Administrator (See 29 CFR Part 1.8 and 29 CFR Part 7). Requests for review and reconsideration can be submitted via email to dba.reconsideration@dol.gov or by mail to:

Wage and Hour Administrator
U.S. Department of Labor
200 Constitution Avenue, N.W.
Washington, DC 20210

The request should be accompanied by a full statement of the interested party's position and any information (wage payment

data, project description, area practice material, etc.) that the requestor considers relevant to the issue.

3) If the decision of the Administrator is not favorable, an interested party may appeal directly to the Administrative Review Board (formerly the Wage Appeals Board). Write to:

Administrative Review Board
U.S. Department of Labor
200 Constitution Avenue, N.W.
Washington, DC 20210.

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END OF GENERAL DECISION
"

C-475

MBE/WBE & SECTION 3 Contact Worksheet

Efforts must show in the use of Minority and Women Owned Business Enterprises (WBE/MBE) and concerns of Section 3 applicable enterprises. A minimum of 3 quotes per trade needs to be acquired. Please complete the required MBE Contact Process form to accompany this document.

Any contractor bidding on a project must show effort in outreach to these classified groups. All contractors must list below MBE/WBE enterprises they have contacted concerning this project. Please note that as part of the bid award process, the jurisdiction and the funding agency will contact enterprises listed by the contractor for verification of this effort. The funding agency will also review this information before approving an award to a contractor. Failure of effort in this requirement could prevent consideration of award to the contractor.

Name of Company	Address	Phone	Contact Name	Date of Contact

I certify the information provided is true and correct, and failure to complete this form or any misrepresentation of information could result in rejection of the bid submission from the company.

Certifying Officer Signature_____ Date_____

City MBE/WBE Contacts List

The following are a list of possible contacts for MBE/WBE usage as it relates to the requirements 24 CFR Part 85.36

1. **https://vendor.myfloridamarketplace.com/search/vendor**
   My Florida Marketplace Vendor Search
2. **https://oevforbusiness.mwsbe.com/**
   City of Tallahassee MBE/DBE Directory
3. **https://oevforbusiness.mwsbe.com/**
   Leon County MWSBE Directory
4. **https://osd.dms.myflorida.com/directories**
   State of Florida DBE/WBE Directory
5. **http://adeca.alabama.gov/Divisions/ced/cdp/Pages/ombe.aspx**
   ADECA Certified WMBE Directory (State of Alabama)
6. **https://pensacola.mwdbe.com/**
   City of Pensacola Certified MBE/WBE Firm Directory

C-480

**CERTIFICATION REGARDING DEBARMENT, SUSPENSION,
AND OTHER RESPONSIBILITY MATTERS PRIMARY COVERED TRANSACTIONS**

(1) The prospective primary participant certifies to the best of its knowledge and belief, that it and its principal:

(a) Are not presently debarred, suspended, proposed for debarment, declared ineligible, or voluntarily excluded from covered transactions by any Federal department or agency;

(b) Have not within a three-year period preceding this proposal been convicted of or had a civil judgment rendered against them for commission of fraud or a criminal offense in connection with obtaining, attempting to obtain, or performing a public (Federal, State or local) transaction or contract under a public transaction; violation of Federal or State antitrust statutes or commission of embezzlement, theft, forgery, bribery, falsification or destruction of records, making false statements, or receiving stolen property;

(c) Are not presently indicted for or otherwise criminally or civilly charged by a governmental entity (Federal, State or local) with commission of any of the offenses enumerated in paragraph (1)(b) of this certification; and

(d) Have not within a three-year period preceding this application/proposal had one or more public transactions (Federal, State or local) terminated for cause or default.

(2) Where the prospective primary participant is unable to certify to any of the statements in this certification, such prospective participant shall attach an explanation to this proposal.

_____
Project Name

_____
Project Number

_____
Name

_____
Title

_____
Firm

_____
Street Address

_____
City, State, Zip

_____
Bidder's Sam.gov #

Registration with Sam.gov is a requirement for bidders to be awarded the contract.

CERTIFICATION REGARDING DEBARMENT, SUSPENSION, INELIGIBILITY AND VOLUNTARY EXCLUSION

Lower Tier Covered Transactions

(1) The prospective lower tier participant certifies, by submission of this document, that neither it nor its principals is presently debarred, suspended, proposed for debarment, declared ineligible, or voluntarily excluded from participation in this transaction by any Federal department or agency.

(2) Where the prospective lower tier participant is unable to certify to the above statement, the prospective participant shall attach an explanation to this form.

_____ _____

Name Local Government

_____ _____

Title CDBG Contract Number

_____

Firm

_____

Street Address

_____

City, State, Zip

_____

Date

C-510

NOTICE OF AWARD

Date of Issuance:			
Owner:	**City of Marianna**	Owner's Project No.:	M0047
Engineer:	**David H. Melvin Inc.**	Engineer's Project No.:	
Contract Name:	**Office Supply Building (AKA: Iralena)**		
Bidder:			
Bidder's Address:			

You are notified that Owner has accepted your Bid dated _____ for the above Contract, and that you are the Successful Bidder and are awarded a Contract for:

_____

_____

_____

The Contract Price of the awarded Contract is $_____. Contract Price is subject to adjustment based on the provisions of the Contract, including but not limited to those governing changes, Unit Price Work, and Work performed on a cost-plus-fee basis, as applicable.

_1___ unexecuted counterparts of the Agreement accompany this Notice of Award, and one copy of the Contract Documents accompanies this Notice of Award or has been transmitted or made available to Bidder electronically.

☐ Drawings will be delivered separately from the other Contract Documents.

You must comply with the following conditions precedent within 15 days of the date of receipt of this Notice of Award:

1. Deliver to Owner __1__ counterparts of the Agreement, signed by Bidder (as Contractor).
2. Deliver with the signed Agreement(s) the Contract security (such as required performance and payment bonds) and insurance documentation, as specified in the Instructions to Bidders and in the General Conditions, Articles 2 and 6.
3. Other conditions precedent (if any):

Failure to comply with these conditions within the time specified will entitle Owner to consider you in default, annul this Notice of Award, and declare your Bid security forfeited. Within 10 days after you comply with the above conditions, Owner will return to you one fully signed counterpart of the Agreement, together with any additional copies of the Contract Documents as indicated in Paragraph 2.02 of the General Conditions.

Owner:	City of Marianna
By *(signature)*:	_____
Name *(printed)*:	William H. Long
Title:	City Manager

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AGREEMENT BETWEEN OWNER AND CONTRACTOR FOR CONSTRUCTION CONTRACT (STIPULATED PRICE)

This Agreement is by and between **City of Marianna** ("Owner") and _____ ("Contractor").

Terms used in this Agreement have the meanings stated in the General Conditions and the Supplementary Conditions.

Owner and Contractor hereby agree as follows:

ARTICLE 1—WORK

1.01 Contractor shall complete all Work as specified or indicated in the Contract Documents. The Work is generally described as follows: demolition/removal of ceiling grid, tiles, light fixtures, heating duct, window units, and concrete block; concrete work; replacement/installation of ceiling and wall insulation, grid and tile; carpentry framing; exterior finishing including brick work, soffit, fascia, ceiling panels, aluminum coil, panels, siding, batten strips, gutter installation; electrical light fixtures, ventilators, fans, and wall receptables; plumbing/ HVAC; and Roofing, per the plans and specifications. Contractor

1.02 The Project, of which the Work under the Contract Documents is a part, is generally described as follows: _____

ARTICLE 2 - ENGINEER

2.01 The Owner has retained **David H. Melvin, Inc.** ("Engineer") to act as Owner's representative, assume all duties and responsibilities of Engineer, and have the rights and authority assigned to Engineer in the Contract.

2.02 The part of the Project that pertains to the Work has been designed by Engineer.

ARTICLE 3 - CONTRACT TIMES

3.01 *Time is of the Essence*

A. All time limits for Milestones, if any, Substantial Completion, and completion and readiness for final payment as stated in the Contract Documents are of the essence of the Contract.

3.02 *Contract Times: Days*

A. The Work will be substantially complete within ___ days after the date when the Contract Times commence to run as provided in Paragraph 4.01 of the General Conditions and completed and ready for final payment in accordance with Paragraph 15.06 of the General Conditions within ___ days after the date when the Contract Times commence to run.

3.03 *Liquidated Damages*

A. Contractor and Owner recognize that time is of the essence as stated in Paragraph 4.01 above and that Owner will suffer financial and other losses if the Work is not completed and Milestones not achieved within the Contract Times, as duly modified. The parties also recognize the delays, expense, and difficulties involved in proving, in a legal or arbitration proceeding, the actual loss suffered by Owner if the Work is not completed on time.

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Accordingly, instead of requiring any such proof, Owner and Contractor agree that as liquidated damages for delay (but not as a penalty):

1. *Substantial Completion:* Contractor shall pay Owner **$**___ for each day that expires after the time (as duly adjusted pursuant to the Contract) specified above for Substantial Completion, until the Work is substantially complete.

2. *Completion of Remaining Work:* After Substantial Completion, if Contractor shall neglect, refuse, or fail to complete the remaining Work within the Contract Times (as duly adjusted pursuant to the Contract) for completion and readiness for final payment, Contractor shall pay Owner **$**___ for each day that expires after such time until the Work is completed and ready for final payment.

4. Liquidated damages for failing to timely attain Substantial Completion and final completion are not additive and will not be imposed concurrently.

B. If Owner recovers liquidated damages for a delay in completion by Contractor, then such liquidated damages are Owner's sole and exclusive remedy for such delay, and Owner is precluded from recovering any other damages, whether actual, direct, excess, or consequential, for such delay, except for special damages (if any) specified in this Agreement.

ARTICLE 4 - CONTRACT PRICE

4.01 Owner shall pay Contractor for completion of the Work in accordance with the Contract Documents, the amounts that follow, subject to adjustment under the Contract:

A. Contract Price is for all Work, at the prices stated in Contractor's Bid, attached hereto as an exhibit. **Contract Price:** _____

4.02 *Submittal and Processing of Payments*

A. Contractor shall submit Applications for Payment in accordance with Article 15 of the General Conditions. Applications for Payment will be processed by Engineer as provided in the General Conditions.

4.03 *Progress Payments; Retainage*

A. Owner shall make progress payments on the basis of Contractor's Applications for Payment on or about the **5th** day of each month during performance of the Work as provided in Paragraph 6.02.A.1 below, provided that such Applications for Payment have been submitted in a timely manner and otherwise meet the requirements of the Contract. All such payments will be measured by the Schedule of Values established as provided in the General Conditions (and in the case of Unit Price Work based on the number of units completed) or, in the event there is no Schedule of Values, as provided elsewhere in the Contract.

1. Prior to Substantial Completion, progress payments will be made in an amount equal to the percentage indicated below but, in each case, less the aggregate of payments previously made and less such amounts as Owner may withhold, including but not limited to liquidated damages, in accordance with the Contract.

a. **95** percent of the value of the Work completed (with the balance being retainage).

1) If 50 percent or more of the Work has been completed, as determined by Engineer, and if the character and progress of the Work have been satisfactory to

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Owner and Engineer, then as long as the character and progress of the Work remain satisfactory to Owner and Engineer, there will be no additional retainage; and

b. **95** percent of cost of materials and equipment not incorporated in the Work (with the balance being retainage).

B. Upon Substantial Completion, Owner shall pay an amount sufficient to increase total payments to Contractor to **100** percent of the Work completed, less such amounts set off by Owner pursuant to Paragraph 15.01.E of the General Conditions, and less **200** percent of Engineer's estimate of the value of Work to be completed or corrected as shown on the punch list of items to be completed or corrected prior to final payment.

4.04 *Final Payment*

A. Upon final completion and acceptance of the Work, Owner shall pay the remainder of the Contract Price in accordance with Paragraph 15.06 of the General Conditions.

4.05 *Consent of Surety*

A. Owner will not make final payment, or return or release retainage at Substantial Completion or any other time, unless Contractor submits written consent of the surety to such payment, return, or release.

4.06 *Interest*

A. All amounts not paid when due will bear interest at the rate of **0** percent per annum.

ARTICLE 5 - CONTRACT DOCUMENTS

5.01 *Contents*

A. The Contract Documents consist of all of the following:

1. This Agreement.
2. Bonds:
   a. Performance bond (together with power of attorney).
   b. Payment bond (together with power of attorney).
3. General Conditions.
4. Supplementary Conditions.
5. Specifications as listed in the table of contents of the project manual (copy of list attached).
6. Drawings (attached), with each sheet bearing the following general title:
7. Contractor's Bid
8. Addenda (numbers ___ to ___ , inclusive).
9. Exhibits to this Agreement (enumerated as follows):
10. The following which may be delivered or issued on or after the Effective Date of the Contract and are not attached hereto:
    a. Notice to Proceed.
    b. Work Change Directives.
    c. Change Orders.
    d. Field Orders.
    e. Warranty Bond, if any.

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B. The Contract Documents listed in Paragraph 7.01.A are attached to this Agreement (except as expressly noted otherwise above).

C. There are no Contract Documents other than those listed above in this Article 7.

D. The Contract Documents may only be amended, modified, or supplemented as provided in the Contract.

ARTICLE 6 - REPRESENTATIONS, CERTIFICATIONS, AND STIPULATIONS

6.01 *Contractor's Representations*

A. In order to induce Owner to enter into this Contract, Contractor makes the following representations:

1. Contractor has examined and carefully studied the Contract Documents, including Addenda.

2. Contractor has visited the Site, conducted a thorough visual examination of the Site and adjacent areas, and become familiar with the general, local, and Site conditions that may affect cost, progress, and performance of the Work.

3. Contractor is familiar with all Laws and Regulations that may affect cost, progress, and performance of the Work.

4. Contractor has carefully studied the reports of explorations and tests of subsurface conditions at or adjacent to the Site and the drawings of physical conditions relating to existing surface or subsurface structures at the Site that have been identified in the Supplementary Conditions, with respect to the Technical Data in such reports and drawings.

5. Contractor has carefully studied the reports and drawings relating to Hazardous Environmental Conditions, if any, at or adjacent to the Site that have been identified in the Supplementary Conditions, with respect to Technical Data in such reports and drawings.

6. Contractor has considered the information known to Contractor itself; information commonly known to contractors doing business in the locality of the Site; information and observations obtained from visits to the Site; the Contract Documents; and the Technical Data identified in the Supplementary Conditions or by definition, with respect to the effect of such information, observations, and Technical Data on (a) the cost, progress, and performance of the Work; (b) the means, methods, techniques, sequences, and procedures of construction to be employed by Contractor; and (c) Contractor's safety precautions and programs.

7. Based on the information and observations referred to in the preceding paragraph, Contractor agrees that no further examinations, investigations, explorations, tests, studies, or data are necessary for the performance of the Work at the Contract Price, within the Contract Times, and in accordance with the other terms and conditions of the Contract.

8. Contractor is aware of the general nature of work to be performed by Owner and others at the Site that relates to the Work as indicated in the Contract Documents.

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9. Contractor has given Engineer written notice of all conflicts, errors, ambiguities, or discrepancies that Contractor has discovered in the Contract Documents, and of discrepancies between Site conditions and the Contract Documents, and the written resolution thereof by Engineer is acceptable to Contractor.

10. The Contract Documents are generally sufficient to indicate and convey understanding of all terms and conditions for performance and furnishing of the Work.

11. Contractor's entry into this Contract constitutes an incontrovertible representation by Contractor that without exception all prices in the Agreement are premised upon performing and furnishing the Work required by the Contract Documents.

6.02 *Contractor's Certifications*

A. Contractor certifies that it has not engaged in corrupt, fraudulent, collusive, or coercive practices in competing for or in executing the Contract. For the purposes of this Paragraph 8.02:

1. "corrupt practice" means the offering, giving, receiving, or soliciting of anything of value likely to influence the action of a public official in the bidding process or in the Contract execution;

2. "fraudulent practice" means an intentional misrepresentation of facts made (a) to influence the bidding process or the execution of the Contract to the detriment of Owner, (b) to establish Bid or Contract prices at artificial non-competitive levels, or (c) to deprive Owner of the benefits of free and open competition;

3. "collusive practice" means a scheme or arrangement between two or more Bidders, with or without the knowledge of Owner, a purpose of which is to establish Bid prices at artificial, non-competitive levels; and

4. "coercive practice" means harming or threatening to harm, directly or indirectly, persons or their property to influence their participation in the bidding process or affect the execution of the Contract.

7.03 *Standard General Conditions*

A. Owner stipulates that if the General Conditions that are made a part of this Contract are EJCDC® C-700, Standard General Conditions for the Construction Contract (2018), published by the Engineers Joint Contract Documents Committee, and if Owner is the party that has furnished said General Conditions, then Owner has plainly shown all modifications to the standard wording of such published document to the Contractor, through a process such as highlighting or "track changes" (redline/strikeout), or in the Supplementary Conditions.

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IN WITNESS WHEREOF, Owner and Contractor have signed this Agreement.

This Agreement will be effective on _____ (which is the Effective Date of the Contract).

Owner:	Contractor:
_____ *(typed or printed name of organization)*	_____ *(typed or printed name of organization)*
By: _____ *(individual's signature)*	By: _____ *(individual's signature)*
Date: _____ *(date signed)*	Date: _____ *(date signed)*
Name: _____ *(typed or printed)*	Name: _____ *(typed or printed)*
Title: _____ *(typed or printed)*	Title: _____ *(typed or printed)*
	*(If **[Type of Entity]** is a corporation, a partnership, or a joint venture, attach evidence of authority to sign.)*
Attest: _____ *(individual's signature)*	Attest: _____ *(individual's signature)*
Title: _____ *(typed or printed)*	Title: _____ *(typed or printed)*
Address for giving notices:	Address for giving notices:
_____	_____
_____	_____
_____	_____
Designated Representative:	Designated Representative:
Name: _____ *(typed or printed)*	Name: _____ *(typed or printed)*
Title: _____ *(typed or printed)*	Title: _____ *(typed or printed)*
Address:	Address:
_____	_____
_____	_____
_____	_____
Phone: _____	Phone: _____
Email: _____	Email: _____
*(If **[Type of Entity]** is a corporation, attach evidence of authority to sign. If **[Type of Entity]** is a public body, attach evidence of authority to sign and resolution or other documents authorizing execution of this Agreement.)*	License No.: _____ *(where applicable)*
	State: _____

EJCDC® C-520, Agreement between Owner and Contractor for Construction Contract (Stipulated Price).
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C-521

CERTIFICATE OF OWNER'S ATTORNEY

I, the undersigned, _____, the duly authorized and acting

legal representative of the **City of Marianna, Florida** do hereby certify as follows:

I have examined the attached contract(s) and surety bonds and the manner of execution thereof, and I am of the opinion that each of the aforesaid agreements has been duly authorized; that said representatives have full power and authority to execute said agreements on behalf of the respective parties named thereon; and that the foregoing agreements constitute valid and legally binding obligations upon the parties executing the same in accordance with terms, conditions and provisions thereof.

_____
Signature

_____
Date

Section C-530
Federal Contract Provisions

Throughout the performance of any work under this Agreement, CONTRACTOR (hereinafter "CONTRACTOR") agrees to abide by the following clauses and requirements:

1. REMEDIES/DISPUTE RESOLUTION/VENUE/CONSTRUCTION
Governing State Law/Severability/Venue/Waiver of Jury Trial. The rights, obligations and remedies of the parties as specified under the Contract shall be interpreted and governed in all aspects by the laws of the State of Florida. Should any provision of the Contract be determined by the courts to be illegal, unenforceable or in conflict with any applicable law, the validity of the remaining provisions shall not be impaired. Venue for litigation of the Contract shall be exclusively in courts of competent jurisdiction located in Jackson County, Florida. The parties waive any and all rights to a jury trial with respect to disputes arising under the Contract.

2. TERMINATION FOR CAUSE AND CONVENIENCE
The County/City/Town may terminate this Agreement without cause, by giving the Contractor written notice of termination. Either party may terminate this Agreement for cause by giving the other party hereto written notice of termination. Termination, with and without cause, shall be effective immediately. In the event of a termination, the Contractor shall be compensated for work satisfactorily completed and irrevocable commitments made prior to such termination. No cancellation fees will be compensated.

3. EQUAL EMPLOYMENT OPPORTUNITY
During the performance of this contract, the contractor agrees as follows:

1) The contractor will not discriminate against any employee or applicant for employment because of race, color, religion, sex, or national origin. The contractor will take affirmative action to ensure that applicants are employed, and that employees are treated during employment without regard to their race, color, religion, sex, or national origin. Such action shall include, but not be limited to the following: Employment, upgrading, demotion, or transfer; recruitment or recruitment advertising; layoff or termination; rates of pay or other forms of compensation; and selection for training, including apprenticeship. The contractor agrees to post in conspicuous places, available to employees and applicants for employment, notices to be provided setting forth the provisions of this nondiscrimination clause.

2) The contractor will, in all solicitations or advertisements for employees placed by or on behalf of the contractor, state that all qualified applicants will receive considerations for employment without regard to race, color, religion, sex, or national origin.

3) The contractor will send to each labor union or representative of workers with which he has a collective bargaining agreement or other contract or understanding, a notice to be provided advising the said labor union or workers' representatives of the contractor's commitments under this section and shall post copies of the notice in conspicuous places available to employees and applicants for employment.

4) The contractor will comply with all provisions of Executive Order 11246 of September 24, 1965, and of the rules, regulations, and relevant orders of the Secretary of Labor.

5) The contractor will furnish all information and reports required by Executive Order 11246 of September

24, 1965, and by rules, regulations, and orders of the Secretary of Labor, or pursuant thereto, and will permit access to his books, records, and accounts by the administering agency and the Secretary of Labor for purposes of investigation to ascertain compliance with such rules, regulations, and orders.

6) In the event of the contractor's noncompliance with the nondiscrimination clauses of this contract or with any of the said rules, regulations, or orders, this contract may be canceled, terminated, or suspended in whole or in part and the contractor may be declared ineligible for further Government contracts or federally assisted construction contracts in accordance with procedures authorized in Executive Order 11246 of September 24, 1965, and such other sanctions as may be imposed and remedies invoked as provided in Executive Order 11246 of September 24, 1965, or by rule, regulation, or order of the Secretary of Labor, or as otherwise provided by law.
7) The contractor will include the portion of the sentence immediately preceding paragraph (1) and the provisions of paragraphs (1) through (7) in every subcontract or purchase order unless exempted by rules, regulations, or orders of the Secretary of Labor issued pursuant to section 204 of Executive Order 11246 of September 24, 1965, so that such provisions will be binding upon each subcontractor or vendor. The contractor will take such action with respect to any subcontract or purchase order as the administering agency may direct as a means of enforcing such provisions, including sanctions for noncompliance: Provided, however, That in the event a contractor becomes involved in, or is threatened with, litigation with a subcontractor or vendor as a result of such direction by the administering agency the contractor may request the United States to enter into such litigation to protect the interests of the United States.

4. DAVIS BACON ACT
During the performance of this contract, the contractor agrees as follows:

1) All transactions regarding this contract shall be done in compliance with the Davis-Bacon Act (40 U.S.C. 3141-3144, and 3146-3148) and the requirements of 29 C.F.R. pt. 5 as may be applicable. The contractor shall comply with 40 U.S.C. 3141-3144, and 3146-3148 and the requirements of 29 C.F.R pt. 5 as applicable.

2) Contractors are required to pay wages to laborers and mechanics at a rate not less than the prevailing wages specified in a wage determination made by the Secretary of Labor.

3) Additionally, contractors are required to pay wages not less than once a week.

4) Contractor shall be required to request additional classifications that are not represented in the Wage Rate but will complete work on the project. The following wage rates shall apply, but not be limited to, the complete listing of current wage rates that are included under C-533.

Contractor shall complete the required Department of Commerce Wage Rate Request form which shall be forwarded to the Town Engineer/Representative. The Town/Town Representative shall forward all additional requests to DEO-CDBG (Florida Commerce) to be processed to the Department of Labor (USDOL). Any payroll payment that does not meet the required DOL Wage Rates determined for each classification must be reimbursed by the contractor to the employees.

By accepting this contract, the Contractor accepts knowledge that additional classifications must be requested from USDOL as part of the contract bid price of this project.

5. COPELAND ANTI-KICKBACK ACT
During the performance of this contract, the contractor agrees as follows:

1) Contractor – The Contractor shall comply with 18 U.S.C. 874, 40 U.S.C 3145, and the requirements of 29 C.F.R pt. 3 as may be applicable, which are incorporated by reference into this

contract.

2) Subcontracts – The contractor or subcontractor shall insert in any subcontracts the clauses above and such other clauses as the Department of Commerce requires and a clause requiring the subcontractors to include these clauses in any lower tier subcontracts. The prime contractor shall be responsible for the compliance by any subcontractor or lower tier subcontractor with all of these contract clauses.

3) Breach – A breach of the contract clauses above may be grounds for termination of the contract, and for debarment as a contractor and subcontractor as provided in 29 C.F.R. 5.12

6. CONTRACT WORK HOURS AND SAFETY STANDARDS ACT
During the performance of this contract, the contractor agrees as follows:

(1) Overtime requirements. No contractor or subcontractor contracting for any part of the contract work which may require or involve the employment of laborers or mechanics shall require or permit any such laborer or mechanic in any workweek in which he or she is employed on such work to work in excess of forty hours in such workweek unless such laborer or mechanic receives compensation at a rate not less than one and one-half times the basic rate of pay for all hours worked in excess of forty hours in such workweek.

(2) Violation; liability for unpaid wages; liquidated damages. In the event of any violation of the clause set forth in paragraph (b)(1) of this section the contractor and any subcontractor responsible therefor shall be liable for the unpaid wages. In addition, such contractor and subcontractor shall be liable to the United States (in the case of work done under contract for the District of Columbia or a territory, to such District or to such territory), for liquidated damages. Such liquidated damages shall be computed with respect to each individual laborer or mechanic, including watchmen and guards, employed in violation of the clause set forth in paragraph (b)(1) of this section, in the sum of $27 for each calendar day on which such individual was required or permitted to work in excess of the standard workweek of forty hours without payment of the overtime wages required by the clause set forth in paragraph (b)(1) of this section.

(3) Withholding for unpaid wages and liquidated damages. The **City** shall upon its own action or upon written request of an authorized representative of the Department of Labor withhold or cause to be withheld, from any moneys payable on account of work performed by the contractor or subcontractor under any such contract or any other Federal contract with the same prime contractor, or any other federally-assisted contract subject to the Contract Work Hours and Safety Standards Act, which is held by the same prime contractor, such sums as may be determined to be necessary to satisfy any liabilities of such contractor or subcontractor for unpaid wages and liquidated damages as provided in the clause set forth in paragraph (b)(2) of this section.
(4) Subcontracts. The contractor or subcontractor shall insert in any subcontracts the clauses set forth in paragraph (b)(1) through (4) of this section and also a clause requiring the subcontractors to include these clauses in any lower tier subcontracts. The prime contractor shall be responsible for compliance by any subcontractor or lower tier subcontractor with the clauses set forth in paragraphs (b)(1) through (4) of this section.

7. RIGHTS TO INVENTIONS – Not applicable to this agreement.

8. CLEAN AIR ACT
The Contractor agrees to comply with all applicable standards, orders or regulations issued pursuant to the Clean Air Act, as amended, 42 U.S.C. § 7401 et seq, when applicable, the Contractor agrees to report

each violation to the County and State of Florida and understands and agrees that the State will, in tum, report each violation as required to assure notification to the appropriate State and Federal grantors and grantees, and the appropriate Environmental Protection Agency Regional Office. The Contractor agrees to include these requirements in each subcontract exceeding $100,000 financed in whole or in part with Federal assistance provided by HUD.

9. FEDERAL WATER POLLUTION CONTROL ACT
The contractor agrees to comply with all applicable standards, orders or regulations issued pursuant to the Federal Water Pollution Control Act, as amended, 33 U.S.C. 1251 et seq. The Contractor agrees to report each violation to the County and State of Florida and understands and agrees that the State will, in turn, report each violation as required to assure notification to the appropriate State and Federal grantors and grantees, the Federal Emergency Management Agency, and the appropriate Environmental Protection Agency Regional Office. The Contractor agrees to include these requirements in each subcontract exceeding $150,000 financed in whole or in part with Federal assistance provided by FEMA.

10. DEBARMENT AND SUSPENSION
This contract is a covered transaction for purposes of 2 C.F.R. pt. 180 and 2 C.F.R. pt. 3000. As such the contractor is required to verify that none of the contractor, its principals (defined at 2 C.F.R. § 180.995), or its affiliates (defined at 2 C.F.R. § 180.905) are excluded (defined at 2 C.F.R. § 180.940) or disqualified (defined at 2 C.F.R. § 180.935). The contractor must comply with 2 C.F.R. pt. 180, subpart C and 2 C.F.R. pt. 3000, subpart C and must include a requirement to comply with these regulations in any lower tier covered transaction it enters into. This certification is a material representation of fact relied upon by the County and State of Florida. If it is later determined that the contractor did not comply with 2 C.F.R. pt. 180, subpart C and 2 C.F.R. pt. 3000, subpart C, in addition to remedies available to all State of Florida, the Federal Government may pursue available remedies, including but not limited to suspension and/or debarment. The bidder or proposer agrees to comply with the requirements of 2 C.F.R. pt. 180, subpart C and 2 C.F.R. pt. 3000, subpart C while this offer is valid and throughout the period of any contract that may arise from this offer. The bidder or proposer further agrees to include a provision requiring such compliance in its lower tier covered transactions.

11. PROCUREMENT OF RECOVERED MATERIALS.
(1) In the performance of this contract, the Contractor shall make maximum use of products containing recovered materials that are EPA- designated items unless the product cannot be acquired— (i) Competitively within a timeframe providing for compliance with the contract performance schedule; (ii) Meeting contract performance requirements; or (iii) At a reasonable price. Information about this requirement, along with the list of EPA-designate items, is available at EPA's Comprehensive Procurement Guidelines web site, https://www.epa.gov/smm/comprehensive-procurement-guideline-cpg-program.The Contractor also agrees to comply with all other applicable requirements of Section 6002 of the Solid Waste Disposal Act.

(2) As appropriate and to the extent consistent with law, the non-Federal entity should, to the greatest extent practicable under a Federal award, provide a preference for the purchase, acquisition, or use of goods, products, or materials produced in the United States (including but not limited to iron, aluminum, steel, cement, and other manufactured products). The requirements of this section must be included in all subawards including all contracts and purchase orders for work or products under this award.

(b) For purposes of this section:

(1) "Produced in the United States" means, for iron and steel products, that all manufacturing processes, from the initial melting stage through the application of coatings, occurred in the

United States.
(2) "Manufactured products" means items and construction materials composed in whole or in part of non-ferrous metals such as aluminum; plastics and polymer-based products such as polyvinyl chloride pipe; aggregates such as concrete; glass, including optical fiber; and lumber.

12. COMPLIANCE WITH FEDERAL LAW, REGULATIONS, AND EXECUTIVE ORDERS
This is an acknowledgement that HUD DEO CDBG-DR funds will be used to fund the contract. The contractor Will comply will all applicable federal law, regulations, executive orders, CDBG policies, procedures, and directives.

13. NO OBLIGATION BY FEDERAL GOVERNMENT
The Federal Government is not a party to this contract and is not subject to any obligations or liabilities to the non-Federal entity, contractor, or any other party pertaining to any matter resulting from the contract.

14. PROGRAM FRAUD AND FALSE OR FRAUDULENT STATEMENTS OR ACTS
The contractor acknowledges that 31 U.S.C. Chap. 38 (Administrative Remedies for False Claims and Statements) applies to the contractor's actions pertaining to this contract.

15. ACCESS TO RECORDS
The contractor agrees to provide Town, applicable State of Florida agencies, the Comptroller General of the United States, or any of their authorized representatives access to any books, documents, papers, and records of the Contractor which are directly pertinent to this contract for the purposes of making audits, examinations, excerpts, and transcriptions. The Contractor agrees to permit any of the foregoing parties to reproduce by any means whatsoever or to copy excerpts and transcriptions as reasonably needed. The contractor agrees to provide the Florida Commerce Administrator or his authorized representatives access to construction or other work sites pertaining to the work being completed under the contract. In compliance with the Disaster Recovery Act of 2018, the Town of Sneads and the Contractor acknowledge and agree that no language in this contract is intended to prohibit audits or internal reviews by the Florida Commerce Administrator or the Comptroller General of the United States.

16. CHANGES AND AMENDMENTS
All changes to, additions to, modifications of, or amendment to this Contract, or any of the terms, provisions, and conditions hereof, shall be binding only when in writing and signed by the authorized officer, agent or representative of each of the parties hereto.

17. BYRD ANTI-LOBBYING AGREEMENT
Contractors who apply or bid for an award of $100,000 or more shall file the required certification. Each tier certifies to the tier above that it will not and has not used Federal appropriated funds to pay any person or organization for influencing or attempting to influence an officer or employee of any agency, a member of Congress, officer or employee of Congress, or an employee of a member of Congress in connection with obtaining any Federal contract grant, or any other award covered by 31 U.S.C. § 1352. Each tier shall also disclose any lobbying with non-Federal funds that takes place in connection with obtaining any Federal award. Such disclosures are forwarded from tier-to-tier up to the recipient.

Attachment L
2 CFR Appendix II to Part 200 - Contract Provisions for Non-Federal Entity Contracts Under Federal Awards

Appendix II to Part 200 - Contract Provisions for Non-Federal Entity Contracts Under Federal Awards

In addition to other provisions required by the Federal agency or non-Federal entity, all contracts made by the non-Federal entity under the Federal award must contain provisions covering the following, as applicable.

(A) Contracts for more than the simplified acquisition threshold, which is the inflation adjusted amount determined by the Civilian Agency Acquisition Council and the Defense Acquisition Regulations Council (Councils) as authorized by 41 U.S.C. 1908, must address administrative, contractual, or legal remedies in instances where contractors violate or breach contract terms, and provide for such sanctions and penalties as appropriate.

(B) All contracts in excess of $10,000 must address termination for cause and for convenience by the non-Federal entity including the manner by which it will be affected and the basis for settlement.

(C) Equal Employment Opportunity. Except as otherwise provided under 41 CFR Part 60, all contracts that meet the definition of "federally assisted construction contract" in 41 CFR Part 60-1.3 must include the equal opportunity clause provided under 41 CFR 60-1.4(b), in accordance with Executive Order 11246, "Equal Employment Opportunity" (30 FR 12319, 12935, 3 CFR Part, 1964-1965 Comp., p. 339), as amended by Executive Order 11375, "Amending Executive Order 11246 Relating to Equal Employment Opportunity," and implementing regulations at 41 CFR part 60, "Office of Federal Contract Compliance Programs, Equal Employment Opportunity, Department of Labor."

(D) Davis-Bacon Act, as amended (40 U.S.C. 3141-3148). When required by Federal program legislation, all prime construction contracts in excess of $2,000 awarded by non-Federal entities must include a provision for compliance with the Davis-Bacon Act (40 U.S.C. 3141-3144, and 3146-3148) as supplemented by Department of Labor regulations (29 CFR Part 5, "Labor Standards Provisions Applicable to Contracts Covering Federally Financed and Assisted Construction"). In accordance with the statute, contractors must be required to pay wages to laborers and mechanics at a rate not less than the prevailing wages specified in a wage determination made by the Secretary of Labor. In addition, contractors must be required to pay wages not less than once a week. The non-Federal entity must place a copy of the current prevailing wage determination issued by the Department of Labor in each solicitation. The decision to award a contract or subcontract must be conditioned upon the acceptance of the wage determination. The non-Federal entity must report all suspected or reported violations to the Federal awarding agency. The contracts must also include a provision for compliance with the Copeland "Anti-Kickback" Act (40 U.S.C. 3145), as supplemented by Department of Labor regulations (29 CFR Part 3, "Contractors and Subcontractors on Public Building or Public Work Financed in Whole or in Part by Loans or Grants from the United States"). The Act provides that each contractor or subrecipient must be prohibited from inducing, by any means, any person employed in the construction, completion, or repair of public work, to give up any part of the compensation to which he or she is otherwise entitled. The non-Federal entity must report all suspected or reported violations to the Federal awarding agency.

(E) Contract Work Hours and Safety Standards Act (40 U.S.C. 3701-3708). Where applicable, all contracts awarded by the non-Federal entity in excess of $100,000 that involve the employment of mechanics or laborers must include a provision for compliance with 40 U.S.C. 3702 and 3704, as supplemented by Department of Labor regulations (29 CFR Part 5). Under 40 U.S.C. 3702 of the Act, each contractor must be required to compute the wages of every mechanic and laborer on the basis of a standard work week of 40 hours. Work in excess of the standard work week is permissible provided that the worker is compensated at a rate of not less than one and a half times the basic rate of pay for all hours worked in excess of 40 hours in the work week. The requirements of 40 U.S.C. 3704 are applicable to construction work and provide that no laborer or mechanic must be required to work in surroundings or

under working conditions which are unsanitary, hazardous or dangerous. These requirements do not apply to the purchases of supplies or materials or articles ordinarily available on the open market, or contracts for transportation or transmission of intelligence.

(F) Rights to Inventions Made Under a Contract or Agreement. If the Federal award meets the definition of "funding agreement" under 37 CFR § 401.2 (a) and the recipient or subrecipient wishes to enter into a contract with a small business firm or nonprofit organization regarding the substitution of parties, assignment or performance of experimental, developmental, or research work under that "funding agreement," the recipient or subrecipient must comply with the requirements of 37 CFR Part 401, "Rights to Inventions Made by Nonprofit Organizations and Small Business Firms Under Government Grants, Contracts and Cooperative Agreements," and any implementing regulations issued by the awarding agency.

(G) Clean Air Act (42 U.S.C. 7401-7671q.) and the Federal Water Pollution Control Act (33 U.S.C. 1251-1387), as amended - Contracts and subgrants of amounts in excess of $150,000 must contain a provision that requires the non-Federal award to agree to comply with all applicable standards, orders or regulations issued pursuant to the Clean Air Act (42 U.S.C. 7401-7671q) and the Federal Water Pollution Control Act as amended (33 U.S.C. 1251-1387). Violations must be reported to the Federal awarding agency and the Regional Office of the Environmental Protection Agency (EPA).

(H) Debarment and Suspension (Executive Orders 12549 and 12689) - A contract award (see 2 CFR 180.220) must not be made to parties listed on the governmentwide exclusions in the System for Award Management (SAM), in accordance with the OMB guidelines at 2 CFR 180 that implement Executive Orders 12549 (3 CFR part 1986 Comp., p. 189) and 12689 (3 CFR part 1989 Comp., p. 235), "Debarment and Suspension." SAM Exclusions contains the names of parties debarred, suspended, or otherwise excluded by agencies, as well as parties declared ineligible under statutory or regulatory authority other than Executive Order 12549.

(I) Byrd Anti-Lobbying Amendment (31 U.S.C. 1352) - Contractors that apply or bid for an award exceeding $100,000 must file the required certification. Each tier certifies to the tier above that it will not and has not used Federal appropriated funds to pay any person or organization for influencing or attempting to influence an officer or employee of any agency, a member of Congress, officer or employee of Congress, or an employee of a member of Congress in connection with obtaining any Federal contract, grant or any other award covered by 31 U.S.C. 1352. Each tier must also disclose any lobbying with non-Federal funds that takes place in connection with obtaining any Federal award. Such disclosures are forwarded from tier to tier up to the non-Federal award.

(J) See 200.323 – Procurement of Recovered Materials.

(K) See 200.216 – Prohibition on certain telecommunications and video surveillance services or equipment.

(L) See 200.322 – Domestic Preferences for procurements.

[78 FR 78608, Dec. 26, 2013, as amended at 79 FR 75888, Dec. 19, 2014; 85 FR 49577, Aug. 13, 2020]

The supplemental conditions contained in this section are intended to cooperate with, to supplement, and to modify the general conditions and other specifications. In case of disagreement with any other section of this contract, the Supplemental Conditions shall govern.

1. Termination (Cause and Convenience)
2. Access to Records
3. Retention of Records
4. Remedies
5. Buy America Preference
6. Environmental Compliance (Clean Air Act and Federal Water Pollution Control Act)
7. Energy Efficiency
8. Conflict of Interest
9. Utilization of Minority- and Women-Owned Business Enterprises (M/WBEs)
10. Davis-Bacon Act
11. Contract Work Hours and Safety Standards Act
12. Health and Safety
13. E-Verify
14. Equal Opportunity Provisions

1. Termination (Cause and Convenience)

A. This contract may be terminated in whole or in part in writing by either party in the event of substantial failure by the other party to fulfill its obligations under this contract through no fault of the terminating party, provided that no termination may be affected unless the other party is given:

(1) not less than ten (10) calendar days written notice (delivered by certified mail, return receipt requested) of intent to terminate; and

(2) an opportunity for consultation with the terminating party prior to termination.

B. This contract may be terminated in whole or in part in writing by the local government for its convenience, provided that the other party is afforded the same notice and consultation opportunity specified in l(a) above.

C. If termination for default is affected by the local government, an equitable adjustment in the price for this contract shall be made, but

(l) no amount shall be allowed for anticipated profit on unperformed services or other work, and

(2) any payment due to the contractor at the time of termination may be adjusted to cover any additional costs to the local government because of the contractor's default.

If termination for convenience is affected by the local government, the equitable adjustment shall include a reasonable profit for services or other work performed for which profit has not already been included in an invoice.

For any termination, the equitable adjustment shall provide for payment to the contractor for services rendered and expenses incurred prior to receipt of the notice of intent to terminate, in addition to termination settlement costs reasonably incurred by the contractor relating to commitments (e.g., suppliers, subcontractors) which had become firm prior to receipt of the notice of intent to terminate.

D. Upon receipt of a termination action under paragraphs (a) or (b) above, the contractor shall (1) promptly discontinue all affected work (unless the notice directs otherwise) and (2) deliver or otherwise make available to the local government all data, drawings, reports specifications,

summaries and other such information, as may have been accumulated by the contractor in performing this contract, whether completed or in progress.

E. Upon termination, the local government may take over the work and may award another party a contract to complete the work described in this contract.

F. If, after termination for failure of the contractor to fulfill contractual obligations, it is determined that the contractor had not failed to fulfill contractual obligations, the termination shall be deemed to have been for the convenience of the local government. In such event, adjustment of the contract price shall be made as provided in paragraph (c) above.

2. Access to Records

The Florida Department of Commerce, the Chief Financial Officer of the State of Florida, the Auditor General of the State of Florida, the Florida Office of Program Policy Analysis and Government Accountability, the U.S. Department of the Treasury, the Comptroller General of the United States, and any of their duly authorized representatives, shall have access to any books, documents, papers, and records, including electronic storage media, as they may relate this contract, for the purposes of conducting audits or examinations or making excerpts or transcriptions.

3. Retention of Records

The contractor shall retain all records relating to this contract for six years after the local government makes final payment and all other pending matters are closed.

4. Remedies

Unless otherwise provided in this contract, all claims, counter-claims, disputes and other matters in question between the local government and the contractor, arising out of or relating to this contract, or the breach of it, will be decided by arbitration, if the parties mutually agree, or in a Florida court of competent jurisdiction.

5. Buy America Preference

A. All iron and steel used in this project must be produced in the United States. This means all manufacturing processes, from the initial melting stage through the application of coatings, occurred in the United States.

B. All manufactured products used in this project must be produced in the United States. This means the manufactured product was manufactured in the United States, and the cost of the components of the manufactured product that are mined, produced, or manufactured in the United States is greater than 55 percent of the total cost of all components of the manufactured product, unless another standard for determining the minimum amount of domestic content of the manufactured product has been established under applicable law or regulation.

C. All constructed materials used in this project must be manufactured in the United States. This means that all manufacturing processes for the construction material occurred in the United States.

D. The Buy America Preference only applies to articles, materials, and supplies that are consumed in, incorporated into, or affixed to an infrastructure project. As such, it does not apply to tools, equipment, and supplies, such as temporary scaffolding, brought to the construction site and removed at or before the completion of the infrastructure project.

6. Environmental Compliance

If this contract exceeds $150,000, the contractor shall comply with all applicable standards, orders or regulations issued pursuant to the Clean Air Act (42 U.S.C. 7401–7671q) and the Federal Water Pollution Control Act as amended (33 U.S.C. 1251–1387). Violations must be reported to the U.S. Department of the Treasury and the Atlanta Regional Office of the Environmental Protection Agency (EPA). The contractor shall include this clause in any subcontracts over $150,000.

7. Energy Efficiency

The contractor shall comply with any mandatory standards and policies relating to energy efficiency which are contained in the state energy conservation plan issued in compliance with the Energy Policy and Conservation Act (Public Law 94-163).

8. Conflict of Interest

No officer or employee of the local jurisdiction or its designees or agents, no member of the governing body, and no other public official of the locality who exercises any function or responsibility with respect to this contract, during his/her tenure or for one year thereafter, shall have any interest, direct or indirect, in any contract or subcontract, or the proceeds thereof, for work to be performed. Further, the contractor shall incorporate the language set forth in this paragraph prohibiting conflict of interest in all subcontracts.

9. Utilization of Minority- and Women-Owned Business Enterprises (M/WBEs)

The contractor shall take all necessary affirmative steps to assure that M/WBE firms are utilized when possible as suppliers and/or subcontractors, as applicable. Prior to contract award, the contractor shall document efforts to utilize M/WBE firms, including identifying what firms were solicited as suppliers and/or subcontractors, as applicable. Information regarding certified M/WBE firms can be obtained from:

- Florida Department of Management Services, Office of Supplier Diversity,
- Florida Department of Transportation (construction services, particularly highway),
- Minority Business Development Center in most major cities, and
- Local government M/WBE programs in many large counties and cities.

A firm recognized as an M/WBE by any of the above agencies is acceptable for the CDBG program.

10. Davis-Bacon Act (Applicable to contracts/subcontracts $2,000 or more)

1. Minimum Wages

(i) All laborers and mechanics employed or working upon the site of the work (or under the United States Housing Act of 1937 or under the Housing Act of 1949 in the construction or development of the project), will be paid unconditionally and not less often than once a week, and without subsequent deduction or rebate on any account (except such payroll deductions as are permitted by regulations issued by the Secretary of Labor under the Copeland Act (29 CFR part 3)), the full amount of wages and bona fide fringe benefits (or cash equivalents thereof) due at time of payment computed at rates not less than those contained in the wage determination of the Secretary of Labor which is attached hereto and made a part hereof, regardless of any contractual relationship which may be alleged to exist between the contractor and such laborers and mechanics. Contributions made or costs reasonably anticipated for bona fide fringe benefits under section 1(b)(2) of the Davis-Bacon Act on behalf of laborers or mechanics are considered wages paid to such laborers or mechanics, subject to the provisions of paragraph (a)(1)(iv) of this section; also, regular contributions made or costs incurred for more than a weekly period (but not

less often than quarterly) under plans, funds, or programs which cover the particular weekly period, are deemed to be constructively made or incurred during such weekly period. Such laborers and mechanics shall be paid the appropriate wage rate and fringe benefits on the wage determination for the classification of work performed, without regard to skill, except as provided in § 5.5(a)(4). Laborers or mechanics performing work in more than one classification may be compensated at the rate specified for each classification for the time worked therein: Provided, That the employer's payroll records accurately set forth the time spent in each classification in which work is performed. The wage determination (including any additional classification and wage rates conformed under paragraph (a)(1)(ii) of this section) and the Davis-Bacon poster (WH–1321) shall be posted at all times by the contractor and its subcontractors at the site of the work in a prominent and accessible place where it can be easily seen by the workers.

(ii) (A) The contracting officer shall require that any class of laborers or mechanics, including helpers, which is not listed in the wage determination, and which is to be employed under the contract shall be classified in conformance with the wage determination. The contracting officer shall approve an additional classification and wage rate and fringe benefits therefore only when the following criteria have been met:

1. The work to be performed by the classification requested is not performed by a classification in the wage determination.
2. The classification is utilized in the area by the construction industry.
3. The proposed wage rate, including any bona fide fringe benefits, bears a reasonable relationship to the wage rates contained in the wage determination.

(B) If the contractor and the laborers and mechanics to be employed in the classification (if known), or their representatives, and the contracting officer agree on the classification and wage rate (including the amount designated for fringe benefits where appropriate), a report of the action taken shall be sent by the contracting officer to the Administrator of the Wage and Hour Division, U.S. Department of Labor, Washington, DC 20210. The Administrator, or an authorized representative, will approve, modify, or disapprove every additional classification action within 30 days of receipt and so advise the contracting officer or will notify the contracting officer within the 30-day period that additional time is necessary.

(C) In the event the contractor, the laborers or mechanics to be employed in the classification or their representatives, and the contracting officer do not agree on the proposed classification and wage rate (including the amount designated for fringe benefits, where appropriate), the contracting officer shall refer the questions, including the views of all interested parties and the recommendation of the contracting officer, to the Administrator for determination. The Administrator, or an authorized representative, will issue a determination within 30 days of receipt and so advise the contracting officer or will notify the contracting officer within the 30-day period that additional time is necessary.

(D) The wage rate (including fringe benefits where appropriate) determined pursuant to paragraphs (a)(1)(ii) (B) or (C) of this section, shall be paid to all workers performing work in the classification under this contract from the first day on which work is performed in the classification.

(iii) Whenever the minimum wage rate prescribed in the contract for a class of laborers or mechanics includes a fringe benefit which is not expressed as an hourly rate, the contractor shall either pay the benefit as stated in the wage determination or shall pay another bona fide fringe benefit or an hourly cash equivalent thereof.

(iv) If the contractor does not make payments to a trustee or other third person, the contractor may consider as part of the wages of any laborer or mechanic the amount of any costs reasonably anticipated in providing bona fide fringe benefits under a plan or program, *Provided*, That the Secretary of Labor has found, upon the written request of the contractor, that the applicable standards of the Davis-Bacon Act have been met. The Secretary of Labor may require the contractor to set aside in a separate account asset for the meeting of obligations under the plan or program.

2. Withholding

The Department of Commerce shall upon its own action or upon written request of an authorized representative of the Department of Labor withhold or cause to be withheld from the contractor under this contract or any other Federal contract with the same prime contractor, or any other federally-assisted contract subject to Davis-Bacon prevailing wage requirements, which is held by the same prime contractor, so much of the accrued payments or advances as may be considered necessary to pay laborers and mechanics, including apprentices, trainees, and helpers, employed by the contractor or any subcontractor the full amount of wages required by the contract. In the event of failure to pay any laborer or mechanic, including any apprentice, trainee, or helper, employed or working on the site of the work (or under the United States Housing Act of 1937 or under the Housing Act of 1949 in the construction or development of the project), all or part of the wages required by the contract, the Department of Commerce may, after written notice to the contractor, sponsor, applicant, or owner, take such action as may be necessary to cause the suspension of any further payment, advance, or guarantee of funds until such violations have ceased.

3. Payrolls and basic records

(i) Payrolls and basic records relating thereto shall be maintained by the contractor during the course of the work and preserved for a period of three years thereafter for all laborers and mechanics working at the site of the work (or under the United States Housing Act of 1937, or under the Housing Act of 1949, in the construction or development of the project). Such records shall contain the name, address, and social security number of each such worker, his or her correct classification, hourly rates of wages paid (including rates of contributions or costs anticipated for bona fide fringe benefits or cash equivalents thereof of the types described in section 1(b)(2)(B) of the Davis-Bacon Act), daily and weekly number of hours worked, deductions made, and actual wages paid. Whenever the Secretary of Labor has found under 29 CFR 5.5(a)(1)(iv) that the wages of any laborer or mechanic include the amount of any costs reasonably anticipated in providing benefits under a plan or program described in section 1(b)(2)(B) of the Davis-Bacon Act, the contractor shall maintain records which show that the commitment to provide such benefits is enforceable, that the plan or program is financially responsible, and that the plan or program has been communicated in writing to the laborers or mechanics affected, and records which show the costs anticipated or the actual cost incurred in providing such benefits. Contractors employing apprentices or trainees under approved programs shall maintain written evidence of the registration of apprenticeship programs and certification of trainee programs, the registration of the apprentices and trainees, and the ratios and wage rates prescribed in the applicable programs.

(ii) (A) The contractor shall submit weekly for each week in which any contract work is performed a copy of all payrolls to the Department of Commerce if the agency is a party to the contract, but if the agency is not such a party, the contractor will submit the payrolls to the applicant, sponsor, or owner, as the case may be, for transmission to the Department of Commerce. The payrolls submitted shall set out accurately and completely all of the information required to be maintained under 29 CFR 5.5(a)(3)(i), except that full social security numbers and home addresses shall not be included on weekly transmittals. Instead, the payrolls shall only need to include an individually identifying

number for each employee (e.g., the last four digits of the employee's social security number). The required weekly payroll information may be submitted in any form desired. Optional Form WH–347 is available for this purpose from the Wage and Hour Division Web site at http://www.dol.gov/esa/whd/forms/wh347instr.htm or its successor site. The prime contractor is responsible for the submission of copies of payrolls by all subcontractors. Contractors and subcontractors shall maintain the full social security number and current address of each covered worker, and shall provide them upon request to the U.S. Department of the Treasury if the agency is a party to the contract, but if the agency is not such a party, the contractor will submit them to the applicant, sponsor, or owner, as the case may be, for transmission to the Department of Commerce, the contractor, or the Wage and Hour Division of the Department of Labor for purposes of an investigation or audit of compliance with prevailing wage requirements. It is not a violation of this section for a prime contractor to require a subcontractor to provide addresses and social security numbers to the prime contractor for its own records, without weekly submission to the sponsoring government agency (or the applicant, sponsor, or owner).

(B) Each payroll submitted shall be accompanied by a “Statement of Compliance,” signed by the contractor or subcontractor or his or her agent who pays or supervises the payment of the persons employed under the contract and shall certify the following:

a. That the payroll for the payroll period contains the information required to be provided under § 5.5 (a)(3)(ii) of Regulations, 29 CFR part 5, the appropriate information is being maintained under § 5.5 (a)(3)(i) of Regulations, 29 CFR part 5, and that such information is correct and complete.

b. That each laborer or mechanic (including each helper, apprentice, and trainee) employed on the contract during the payroll period has been paid the full weekly wages earned, without rebate, either directly or indirectly, and that no deductions have been made either directly or indirectly from the full wages earned, other than permissible deductions as set forth in Regulations, 29 CFR part 3.

c. That each laborer or mechanic has been paid not less than the applicable wage rates and fringe benefits or cash equivalents for the classification of work performed, as specified in the applicable wage determination incorporated into the contract.

(C) The weekly submission of a properly executed certification set forth on the reverse side of Optional Form WH–347 shall satisfy the requirement for submission of the “Statement of Compliance” required by paragraph (a)(3)(ii)(B) of this section.

(D) The falsification of any of the above certifications may subject the contractor or subcontractor to civil or criminal prosecution under section 1001 of title 18 and section 231 of title 31 of the United States Code.

(iii) The contractor or subcontractor shall make the records required under paragraph (a)(3)(i) of this section available for inspection, copying, or transcription by authorized representatives of the Department of Commerce or the Department of Labor, and shall permit such representatives to interview employees during working hours on the job. If the contractor or subcontractor fails to submit the required records or to make them available, the Federal agency may, after written notice to the contractor, sponsor, applicant, or owner, take such action as may be necessary to cause the suspension of any further payment, advance, or guarantee of funds. Furthermore, failure to submit the required records upon request or to make such records available may be grounds for debarment action pursuant to 29 CFR 5.12.

4. Apprentices and Trainees

(i) *Apprentices*. Apprentices will be permitted to work at less than the predetermined rate for the work they performed when they are employed pursuant to and individually registered in a bona fide apprenticeship program registered with the U.S. Department of Labor, Employment and Training Administration, Office of Apprenticeship Training, Employer and Labor Services, or with a State Apprenticeship Agency recognized by the Office, or if a person is employed in his or her first 90 days of probationary employment as an apprentice in such an apprenticeship program, who is not individually registered in the program, but who has been certified by the Office of Apprenticeship Training, Employer and Labor Services or a State Apprenticeship Agency (where appropriate) to be eligible for probationary employment as an apprentice. The allowable ratio of apprentices to journeymen on the job site in any craft classification shall not be greater than the ratio permitted to the contractor as to the entire work force under the registered program. Any worker listed on a payroll at an apprentice wage rate, who is not registered or otherwise employed as stated above, shall be paid not less than the applicable wage rate on the wage determination for the classification of work performed. In addition, any apprentice performing work on the job site in excess of the ratio permitted under the registered program shall be paid not less than the applicable wage rate on the wage determination for the work actually performed. Where a contractor is performing construction on a project in a locality other than that in which its program is registered, the ratios and wage rates (expressed in percentages of the journeyman's hourly rate) specified in the contractor's or subcontractor's registered program shall be observed. Every apprentice must be paid at not less than the rate specified in the registered program for the apprentice's level of progress, expressed as a percentage of the journeymen hourly rate specified in the applicable wage determination. Apprentices shall be paid fringe benefits in accordance with the provisions of the apprenticeship program. If the apprenticeship program does not specify fringe benefits, apprentices must be paid the full amount of fringe benefits listed on the wage determination for the applicable classification. If the Administrator determines that a different practice prevails for the applicable apprentice classification, fringes shall be paid in accordance with that determination. In the event the Office of Apprenticeship Training, Employer and Labor Services, or a State Apprenticeship Agency recognized by the Office, withdraws approval of an apprenticeship program, the contractor will no longer be permitted to utilize apprentices at less than the applicable predetermined rate for the work performed until an acceptable program is approved.

(ii) *Trainees*. Except as provided in 29 CFR 5.16, trainees will not be permitted to work at less than the predetermined rate for the work performed unless they are employed pursuant to and individually registered in a program which has received prior approval, evidenced by formal certification by the U.S. Department of Labor, Employment and Training Administration. The ratio of trainees to journeymen on the job site shall not be greater than permitted under the plan approved by the Employment and Training Administration. Every trainee must be paid at not less than the rate specified in the approved program for the trainee's level of progress, expressed as a percentage of the journeyman hourly rate specified in the applicable wage determination. Trainees shall be paid fringe benefits in accordance with the provisions of the trainee program. If the trainee program does not mention fringe benefits, trainees shall be paid the full amount of fringe benefits listed on the wage determination unless the Administrator of the Wage and Hour Division determines that there is an apprenticeship program associated with the corresponding journeyman wage rate on the wage determination which provides for less than full fringe benefits for apprentices. Any employee listed on the payroll at a trainee rate who is not registered and participating in a training plan approved by the Employment and Training Administration shall be paid not less than the applicable wage rate on the wage determination for the classification of work performed. In addition, any trainee performing work on the job site in excess of the ratio permitted under the registered program shall be paid not less than the applicable wage rate on the wage determination for the work actually performed. In the event the Employment and Training Administration withdraws approval of a training program, the contractor will no longer be

permitted to utilize trainees at less than the applicable predetermined rate for the work performed until an acceptable program is approved.

(iii) *Equal Employment Opportunity*. The utilization of apprentices, trainees and journeymen under this part shall be in conformity with the equal employment opportunity requirements of Executive Order 11246, as amended, and 29 CFR part 30.

5. Compliance with Copeland Act requirements

The contractor shall comply with the requirements of 29 CFR part 3, which are incorporated by reference in this contract.

6. Subcontracts

The contractor or subcontractor shall insert in any subcontracts the clauses contained in 29 CFR 5.5(a)(1) through (10) and such other clauses as the U.S. Department of the Treasury may by appropriate instructions require, and also a clause requiring the subcontractors to include these clauses in any lower tier subcontracts. The prime contractor shall be responsible for the compliance by any subcontractor or lower tier subcontractor with all the contract clauses in 29 CFR 5.5.

7. Contract termination: debarment

A breach of the contract clauses in 29 CFR 5.5 may be grounds for termination of the contract, and for debarment as a contractor and a subcontractor as provided in 29 CFR 5.12.

8. Compliance with Davis-Bacon and Related Act requirements

All rulings and interpretations of the Davis-Bacon and Related Acts contained in 29 CFR parts 1, 3, and 5 are herein incorporated by reference in this contract.

9. Disputes concerning labor standards

Disputes arising out of the labor standards provisions of this contract shall not be subject to the general disputes clause of this contract. Such disputes shall be resolved in accordance with the procedures of the Department of Labor set forth in 29 CFR parts 5, 6, and 7. Disputes within the meaning of this clause include disputes between the contractor (or any of its subcontractors) and the contracting agency, the U.S. Department of Labor, or the employees or their representatives.

10. Certification of eligibility

(i) By entering into this contract, the contractor certifies that neither it (nor he or she) nor any person or firm who has an interest in the contractor's firm is a person or firm ineligible to be awarded Government contracts by virtue of section 3(a) of the Davis-Bacon Act or 29 CFR 5.12(a)(1).

(ii) No part of this contract shall be subcontracted to any person or firm ineligible for award of a Government contract by virtue of section 3(a) of the Davis-Bacon Act or 29 CFR 5.12(a)(1).

(iii) The penalty for making false statements is prescribed in the U.S. Criminal Code, 18 U.S.C. 1001.

11. Contract Work Hours and Safety Standards Act (Applicable to contracts/subcontracts $100,000 or more)

1. Overtime requirements

No contractor or subcontractor contracting for any part of the contract work which may require or involve the employment of laborers or mechanics shall require or permit any such laborer or mechanic in any workweek in which he or she is employed on such work to work in excess of forty hours in such workweek unless such laborer or mechanic receives compensation at a rate not less than one and one-half times the basic rate of pay for all hours worked in excess of forty hours in such workweek.

2. Violation; liability for unpaid wages; liquidated damages

In the event of any violation of the clause set forth in paragraph (1.) of this section the contractor and any subcontractor responsible therefor shall be liable for the unpaid wages. In addition, such contractor and subcontractor shall be liable to the United States (in the case of work done under contract for the District of Columbia or a territory, to such District or to such territory), for liquidated damages. Such liquidated damages shall be computed with respect to each individual laborer or mechanic, including watchmen and guards, employed in violation of the clause set forth in paragraph (1.) of this section, in the sum of $31 for each calendar day on which such individual was required or permitted to work in excess of the standard workweek of forty hours without payment of the overtime wages required by the clause set forth in paragraph (1.) of this section.

3. Withholding for unpaid wages and liquidated damages

The Department of Commerce shall upon its own action or upon written request of an authorized representative of the Department of Labor withhold or cause to be withheld, from any moneys payable on account of work performed by the contractor or subcontractor under any such contract or any other Federal contract with the same prime contractor, or any other federally-assisted contract subject to the Contract Work Hours and Safety Standards Act, which is held by the same prime contractor, such sums as may be determined to be necessary to satisfy any liabilities of such contractor or subcontractor for unpaid wages and liquidated damages as provided in the clause set forth in paragraph (2.) of this section.

4. Subcontracts

The contractor or subcontractor shall insert in any subcontracts the clauses set forth in paragraph (1.) through (4.) of this section and also a clause requiring the subcontractors to include these clauses in any lower tier subcontracts. The prime contractor shall be responsible for compliance by any subcontractor or lower tier subcontractor with the clauses set forth in paragraphs (1.) through (4.) of this section.

12. Health and Safety

(1) No laborer or mechanic shall be required to work in surroundings or under working conditions which are unsanitary, hazardous, or dangerous to his health and safety as determined under construction safety and health standards promulgated by the Secretary of Labor by regulation.

(2) The contractor shall comply with all regulations issued by the Secretary of Labor pursuant to Title 29 Part 1926 (formerly part 1518) and failure to comply may result in imposition of sanctions pursuant to the Contract Work Hours and Safety Standards Act (Public Law 91-54.83 State 96).

(3) The contractor shall include the provisions of this Article in every subcontract so that such provisions will be binding on each subcontractor. The contractor shall take such action with respect to any subcontract as the Secretary of the Treasury or the Secretary of Labor shall direct as a means of enforcing such provisions.

13. E-Verify

A. Section 448.095, Florida Statutes, requires the following:

1. Every public agency and its contractors and subcontractors shall register with and use the E-Verify system to verify the work authorization status of all newly hired employees. A public agency or a contractor or subcontractor thereof may not enter into a contract unless each party to the contract registers with and uses the E-Verify system.
2. An employer shall verify each new employee's employment eligibility within three (3) business days after the first day that the new employee begins working for pay as required

under 8 CFR 274a. Beginning July 1, 2023, a private employer with 25 or more employees shall use the E-Verify system to verify a new employee's employment eligibility.

B. E-Verify is an Internet-based system that allows an employer, using information reported on an employee's Form I-9, Employment Eligibility Verification, to determine the eligibility of all new employees hired to work in the United States. There is no charge to employers to use E-Verify. The Department of Homeland Security's E-Verify system can be found at:

https://www.e-verify.gov/.

C. If the contractor does not use E-Verify, the contractor shall enroll in the E-Verify system prior to hiring any new employee or retaining any contract employee after the effective date of this contract.

14. Equal Opportunity Provisions

A. Standard Federal Equal Employment Opportunity Construction Contract Specifications (Applicable to contracts/subcontracts above $10,000)

1. As used in these specifications:

(a). "Covered area" means the geographical area described in the solicitation from which this contract resulted.

(b). "Director" means Director, Office of Federal Contract Compliance Programs, United States Department of Labor, or any person to whom the Director delegates authority.

(c). "Employer identification number" means the Federal Social Security number used on the Employer's Quarterly Federal Tax Return, U.S. Treasury Department Form 941.

(d). "Minority" includes:

(i) Black (all persons having origins in any of the Black African racial groups not of Hispanic origin).

(ii) Hispanic (all persons of Mexican, Puerto Rican, Cuban, Central or South American or other Spanish Culture or origin, regardless of race).

(iii) Asian and Pacific Islander (all persons having origins in any of the original peoples of the Far East, Southeast Asia, the Indian Subcontinent, or the Pacific Islands).

(iv) American Indian or Alaskan Native (all persons having origins in any of the original peoples of North America and maintaining identifiable tribal affiliations through membership and participation or community identification).

2. Whenever the Contractor, or any Subcontractor at any tier, subcontracts a portion of the work involving any construction trade, it shall physically include in each subcontract in excess of $10,000 the provisions of these specifications and the Notice which contains the applicable goals for minority and female participation, and which is set forth in the solicitations from which this contract resulted.

3. If the Contractor is participating (pursuant to 41 CFR 60–4.5) in a Hometown Plan approved by the U.S. Department of Labor in the covered area either individually or through an association, its affirmative action obligations on all work in the Plan area (including goals and timetables) shall be in accordance with that Plan for those trades which have unions participating in the Plan. Contractors must be able to demonstrate their participation in and compliance with the provisions

of any such Hometown Plan. Each Contractor or Subcontractor participating in an approved Plan is individually required to comply with its obligations under the EEO clause, and to make a good faith effort to achieve each goal under the Plan in each trade in which it has employees. The overall good faith performance by other Contractors or Subcontractors toward a goal in an approved Plan does not excuse any covered Contractor's or Subcontractor's failure to take good faith efforts to achieve the Plan goals and timetables.

4. The Contractor shall implement the specific affirmative action standards provided in paragraphs 7 (a) through (p) of these specifications. The goals set forth in the solicitation from which this contract resulted are expressed as percentages of the total hours of employment and training of minority and female utilization the Contractor should reasonably be able to achieve in each construction trade in which it has employees in the covered area. Covered Construction contractors performing construction work in geographical areas where they do not have a Federal or federally assisted construction contract shall apply the minority and female goals established for the geographical area where the work is being performed. Goals are published periodically in the *Federal Register* in notice form, and such notices may be obtained from any Office of Federal Contract Compliance Programs office or from Federal procurement contracting officers. The Contractor is expected to make substantially uniform progress in meeting its goals in each craft during the period specified.

5. Neither the provisions of any collective bargaining agreement, nor the failure by a union with whom the Contractor has a collective bargaining agreement, to refer either minorities or women shall excuse the Contractor's obligations under these specifications, Executive Order 11246, or the regulations promulgated pursuant thereto.

6. In order for the nonworking training hours of apprentices and trainees to be counted in meeting the goals, such apprentices and trainees must be employed by the Contractor during the training period, and the Contractor must have made a commitment to employ the apprentices and trainees at the completion of their training, subject to the availability of employment opportunities. Trainees must be trained pursuant to training programs approved by the U.S. Department of Labor.

7. The Contractor shall take specific affirmative actions to ensure equal employment opportunity. The evaluation of the Contractor's compliance with these specifications shall be based upon its effort to achieve maximum results from its actions. The Contractor shall document these efforts fully, and shall implement affirmative action steps at least as extensive as the following:

> (a). Ensure and maintain a working environment free of harassment, intimidation, and coercion at all sites, and in all facilities at which the Contractor's employees are assigned to work. The Contractor, where possible, will assign two or more women to each construction project. The Contractor shall specifically ensure that all foremen, superintendents, and other on-site supervisory personnel are aware of and carry out the Contractor's obligation to maintain such a working environment, with specific attention to minority or female individuals working at such sites or in such facilities.
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> (b). Establish and maintain a current list of minority and female recruitment sources, provide written notification to minority and female recruitment sources and to community organizations when the Contractor or its unions have employment opportunities available, and maintain a record of the organizations' responses.
>
> (c). Maintain a current file of the names, addresses and telephone numbers of each minority and female off-the-street applicant and minority or female referral from a union, a recruitment source or community organization and of what action was taken with respect to each such individual. If such individual was sent to the union hiring hall for referral and

was not referred back to the Contractor by the union or, if referred, not employed by the Contractor, this shall be documented in the file with the reason therefor, along with whatever additional actions the Contractor may have taken.

(d). Provide immediate written notification to the Director when the union or unions with which the Contractor has a collective bargaining agreement has not referred to the Contractor a minority person or woman sent by the Contractor, or when the Contractor has other information that the union referral process has impeded the Contractor's efforts to meet its obligations.

(e). Develop on-the-job training opportunities and/or participate in training programs for the area which expressly include minorities and women, including upgrading programs and apprenticeship and trainee programs relevant to the Contractor's employment needs, especially those programs funded or approved by the Department of Labor. The Contractor shall provide notice of these programs to the sources compiled under 7(b) above.

(f). Disseminate the Contractor's EEO policy by providing notice of the policy to unions and training programs and requesting their cooperation in assisting the Contractor in meeting its EEO obligations; by including it in any policy manual and collective bargaining agreement; by publicizing it in the company newspaper, annual report, etc.; by specific review of the policy with all management personnel and with all minority and female employees at least once a year; and by posting the company EEO policy on bulletin boards accessible to all employees at each location where construction work is performed.

(g). Review, at least annually, the company's EEO policy and affirmative action obligations under these specifications with all employees having any responsibility for hiring, assignment, layoff, termination or other employment decisions including specific review of these items with onsite supervisory personnel such as Superintendents, General Foremen, etc., prior to the initiation of construction work at any job site. A written record shall be made and maintained identifying the time and place of these meetings, persons attending, subject matter discussed, and disposition of the subject matter.

(h). Disseminate the Contractor's EEO policy externally by including it in any advertising in the news media, specifically including minority and female news media, and providing written notification to and discussing the Contractor's EEO policy with other Contractors and Subcontractors with whom the Contractor does or anticipates doing business.

(i). Direct its recruitment efforts, both oral and written, to minority, female and community organizations, to schools with minority and female students and to minority and female recruitment and training organizations serving the Contractor's recruitment area and employment needs. Not later than one month prior to the date for the acceptance of applications for apprenticeship or other training by any recruitment source, the Contractor shall send written notification to organizations such as the above, describing the openings, screening procedures, and tests to be used in the selection process.

(j). Encourage present minority and female employees to recruit other minority persons and women and, where reasonable, provide after school, summer and vacation employment to minority and female youth both on the site and in other areas of a Contractor's work force.

(k). Validate all tests and other selection requirements where there is an obligation to do so under 41 CFR part 60–3.

(l). Conduct, at least annually, an inventory and evaluation at least of all minority and female personnel for promotional opportunities and encourage these employees to seek or to prepare for, through appropriate training, etc., such opportunities.

(m). Ensure that seniority practices, job classifications, work assignments and other personnel practices, do not have a discriminatory effect by continually monitoring all personnel and employment related activities to ensure that the EEO policy and the Contractor's obligations under these specifications are being carried out.

(n). Ensure that all facilities and company activities are nonsegregated except that separate or single-user toilet and necessary changing facilities shall be provided to assure privacy between the sexes.

(o). Document and maintain a record of all solicitations of offers for subcontracts from minority and female construction contractors and suppliers, including circulation of solicitations to minority and female contractor associations and other business associations.

(p). Conduct a review, at least annually, of all supervisors' adherence to and performance under the Contractor's EEO policies and affirmative action obligations.

8. Contractors are encouraged to participate in voluntary associations which assist in fulfilling one or more of their affirmative action obligations (7a through p). The efforts of a contractor association, joint contractor-union, contractor-community, or other similar group of which the contractor is a member and participant, may be asserted as fulfilling any one or more of its obligations under 7a through p of these Specifications provided that the contractor actively participates in the group, makes every effort to assure that the group has a positive impact on the employment of minorities and women in the industry, ensures that the concrete benefits of the program are reflected in the Contractor's minority and female workforce participation, makes a good faith effort to meet its individual goals and timetables, and can provide access to documentation which demonstrates the effectiveness of actions taken on behalf of the Contractor. The obligation to comply, however, is the Contractor's and failure of such a group to fulfill an obligation shall not be a defense for the Contractor's noncompliance.

9. A single goal for minorities and a separate single goal for women have been established. The Contractor, however, is required to provide equal employment opportunity and to take affirmative action for all minority groups, both male and female, and all women, both minority and non-minority. Consequently, the Contractor may be in violation of the Executive Order if a particular group is employed in a substantially disparate manner (for example, even though the Contractor has achieved its goals for women generally, the Contractor may be in violation of the Executive Order if a specific minority group of women is underutilized).

10. The Contractor shall not use the goals and timetables or affirmative action standards to discriminate against any person because of race, color, religion, sex, sexual orientation, gender identity, or national origin.

11. The Contractor shall not enter into any Subcontract with any person or firm debarred from Government contracts pursuant to Executive Order 11246.

12. The Contractor shall carry out such sanctions and penalties for violation of these specifications and of the Equal Opportunity Clause, including suspension, termination and cancellation of existing subcontracts as may be imposed or ordered pursuant to Executive Order 11246, as amended, and its implementing regulations, by the Office of Federal Contract Compliance Programs. Any Contractor who fails to carry out such sanctions and penalties shall be in violation of these specifications and Executive Order 11246, as amended.

13. The Contractor, in fulfilling its obligations under these specifications, shall implement specific affirmative action steps, at least as extensive as those standards prescribed in paragraph 7 of these specifications, so as to achieve maximum results from its efforts to ensure equal employment opportunity. If the Contractor fails to comply with the requirements of the Executive Order, the implementing regulations, or these specifications, the Director shall proceed in accordance with 41 CFR 60–4.8.

14. The Contractor shall designate a responsible official to monitor all employment related activity to ensure that the company EEO policy is being carried out, to submit reports relating to the provisions hereof as may be required by the Government and to keep records. Records shall at least include for each employee the name, address, telephone numbers, construction trade, union affiliation if any, employee identification number when assigned, social security number, race, sex, status (e.g., mechanic, apprentice trainee, helper, or laborer), dates of changes in status, hours worked per week in the indicated trade, rate of pay, and locations at which the work was performed. Records shall be maintained in an easily understandable and retrievable form; however, to the degree that existing records satisfy this requirement, contractors shall not be required to maintain separate records.

15. Nothing herein provided shall be construed as a limitation upon the application of other laws which establish different standards of compliance or upon the application of requirements for the hiring of local or other area residents (e.g., those under the Public Works Employment Act of 1977 and the Community Development Block Grant Program).

B. Contracts Not Subject to Executive Order 11246, as Amended (Applicable to contracts/subcontracts $10,000 and under)

During the performance of this contract, the contractor agrees as follows:

(1) The contractor will not discriminate against any employee or applicant for employment because of race, color, religion, sex, sexual orientation, gender identity, or national origin. The contractor will take affirmative action to ensure that applicants are employed, and that employees are treated during employment, without regard to their race, color, religion, sex, sexual orientation, gender identity, or national origin. Such action shall include, but not be limited to the following: employment, upgrading, demotion, or transfer; recruitment or recruitment advertising; layoff or termination; rates of pay or other forms of compensation; and selection for training, including apprenticeship.

(2) The contractor agrees to post in conspicuous places, available to employees and applicants for employment, notices to be provided by the contracting officer setting forth the provisions of this nondiscrimination clause.

(3) Contractors shall incorporate foregoing requirements in all subcontracts.

C. Equal Opportunity Clause (Applicable to contracts/subcontracts above $10,000)

During the performance of this contract, the contractor agrees as follows:

(1) The contractor will not discriminate against any employee or applicant for employment because of race, color, religion, sex, sexual orientation, gender identity, or national origin. The contractor will take affirmative action to ensure that applicants are employed, and that employees are treated during employment without regard to their race, color, religion, sex, sexual orientation, gender identity, or national origin. Such action shall include, but not be limited to the following: Employment, upgrading, demotion, or transfer; recruitment or recruitment advertising; layoff or termination; rates of pay or other forms of compensation; and selection for training, including apprenticeship. The contractor agrees to post in

conspicuous places, available to employees and applicants for employment, notices to be provided setting forth the provisions of this nondiscrimination clause.

(2) The contractor will, in all solicitations or advertisements for employees placed by or on behalf of the contractor, state that all qualified applicants will receive consideration for employment without regard to race, color, religion, sex, sexual orientation, gender identity, or national origin.

(3) The contractor will not discharge or in any other manner discriminate against any employee or applicant for employment because such employee or applicant has inquired about, discussed, or disclosed the compensation of the employee or applicant or another employee or applicant. This provision shall not apply to instances in which an employee who has access to the compensation information of other employees or applicants as a part of such employee's essential job functions discloses the compensation of such other employees or applicants to individuals who do not otherwise have access to such information, unless such disclosure is in response to a formal complaint or charge, in furtherance of an investigation, proceeding, hearing, or action, including an investigation conducted by the employer, or is consistent with the contractor's legal duty to furnish information.

(4) The contractor will send to each labor union or representative of workers with which he has a collective bargaining agreement or other contract or understanding, a notice to be provided advising the said labor union or workers' representatives of the contractor's commitments under this section and shall post copies of the notice in conspicuous places available to employees and applicants for employment.

(5) The contractor will comply with all provisions of Executive Order 11246 of September 24, 1965, and of the rules, regulations, and relevant orders of the Secretary of Labor.

(6) The contractor will furnish all information and reports required by Executive Order 11246 of September 24, 1965, and by rules, regulations, and orders of the Secretary of Labor, or pursuant thereto, and will permit access to his books, records, and accounts by the administering agency and the Secretary of Labor for purposes of investigation to ascertain compliance with such rules, regulations, and orders.

(7) In the event of the contractor's noncompliance with the nondiscrimination clauses of this contract or with any of the said rules, regulations, or orders, this contract may be canceled, terminated, or suspended in whole or in part and the contractor may be declared ineligible for further Government contracts or federally assisted construction contracts in accordance with procedures authorized in Executive Order 11246 of September 24, 1965, and such other sanctions may be imposed and remedies invoked as provided in Executive Order 11246 of September 24, 1965, or by rule, regulation, or order of the Secretary of Labor, or as otherwise provided by law.

(8) The contractor will include the portion of the sentence immediately preceding paragraph (1) and the provisions of paragraphs (1) through (8) in every subcontract or purchase order unless exempted by rules, regulations, or orders of the Secretary of Labor issued pursuant to section 204 of Executive Order 11246 of September 24, 1965, so that such provisions will be binding upon each subcontractor or vendor. The contractor will take such action with respect to any subcontract or purchase order as the administering agency may direct as a means of enforcing such provisions, including sanctions for noncompliance: *Provided*, however, that in the event a contractor becomes involved in, or is threatened with, litigation with a subcontractor or vendor as a result of such direction by the administering agency, the contractor may request the United States to enter into such litigation to protect the interests of the United States.

D. Civil Rights Act of 1964

Under Title VI of the Civil Rights Act of 1964, no person shall, on the grounds of race, color, religion, sex, or national origin, be excluded from participation in, be denied the benefits of, or be subjected to discrimination under any program or activity receiving Federal financial assistance.

E. Age Discrimination in Employment Act of 1967, as Amended

It shall be unlawful for an employer-

(1) To fail or refuse to hire or to discharge any individual or otherwise discriminate against any individual with respect to his compensation, terms, conditions, or privileges of employment, because of such individual's age.

(2) To limit, segregate, or classify his employees in any way which would deprive or tend to deprive any individual of employment opportunities or otherwise adversely affect his status as an employee, because of such individual's age.

(3) To reduce the wage rate of any employee in order to comply with this section.

F. Title II of the Genetic Information Nondiscrimination Act of 2008

(1) Under Title II of the Genetic Information Nondiscrimination Act (GINA), it is illegal to discriminate against employees or applicants because of genetic information. Employers are prohibited from using genetic information in making employment decisions. GINA restricts employers and other entities covered by Title II (employment agencies, labor organizations and joint labor-management training and apprenticeship programs - referred to as "covered entities") from requesting, requiring or purchasing genetic information, and strictly limits the disclosure of genetic information.

The law forbids discrimination on the basis of genetic information when it comes to any aspect of employment, including hiring, firing, pay, job assignments, promotions, layoffs, training, fringe benefits, or any other term or condition of employment.

(2) "Genetic information" includes information about an individual's genetic tests and the genetic tests of an individual's family members, as well as information about the manifestation of a disease or disorder in an individual's family members (i.e. family medical history). Family medical history is included in the definition of genetic information because it is often used to determine whether someone has an increased risk of getting a disease, disorder, or condition in the future.

G. Section 3 of the Housing and Urban Development Act of 1968

(1) The work to be performed under this contract is subject to the requirements of Section 3 of the Housing and Urban Development Act of 1968, as amended, 12 U.S.C. 1701u (Section3), contributes to the establishment of stronger, more sustainable communities by ensuring that employment and other economic opportunities generated by Federal financial assistance for housing and community development programs are, to the greatest extent feasible, directed toward low- and very low-income persons, particularly those who receive Federal financial assistance for housing and those residing in communities where the financial assistance is expended.

(2) The parties to this contract agree to comply with HUD's regulations in 24 CFR part 75, which implement section 3. As evidenced by their execution of this contract, the parties to this contract certify that they are under no contractual or other impediment that would prevent them from complying with the part 75 regulations.

(3) The contractor agrees to send to each labor organization or representative or workers with which the contractor has a collective bargaining agreement or other understanding, if any, a notice advising the labor organization or workers' representative of the contractor's

commitments under this Section 3 clause and will post copies of the notice in conspicuous places at the work site where both employees and applicants for training and employment positions can see the notice. The notice shall describe the Section 3 preference, shall set forth minimum number and job titles subject to hire, availability of apprenticeship and training positions, the qualifications for each; and the name and location of the person(s)taking applications for each of the positions; and the anticipated date the work shall begin.

(4) The Contractor agrees to include this section 3 clause in every subcontract subject to compliance with regulations in 24 CFR part 75, and agrees to take appropriate action, as provided in an applicable provision of the subcontract or in this section 3 clause, upon a finding that the subcontractor is in violation of the regulations in 24 CFR part 75. The Contractor will not subcontract with any subcontractor where the contractor has notice or knowledge that the subcontractor has been found in violation of the regulations in 24 CFR part 75.

(5) The Contractor will certify that any vacant employment positions, including training positions, that are filled (1) after the Contractor is selected but before the contract is executed, and (2) with persons other than those to whom the regulations of 24 CFR part 75 require employment opportunities to be directed, were not filled to circumvent the contractor's obligations under 24 CFR part 75.

(6) Noncompliance with HUD's regulations in 24 CFR part 75 may result in sanctions, termination of this Contract for default, and debarment or suspension from future HUD assisted contracts.

NOTICE TO PROCEED

Owner:	City of Marianna	Owner's Project No.:	M0047
Engineer:	David H. Melvin, Inc.	Engineer's Project No.:	MAR22HR
Contractor:		Contractor's Project No.:	
Project:	Office Supply Building (AKA: Iralena)		
Contract Name:			
Effective Date of Contract:			

Owner hereby notifies Contractor that the Contract Times under the above Contract will commence to run on _____ pursuant to Paragraph 4.01 of the General Conditions.

On that date, Contractor shall start performing its obligations under the Contract Documents. No Work will be done at the Site prior to such date.

In accordance with the Agreement:

The number of days to achieve Substantial Completion is ___ consecutive calendar days from the date stated above for the commencement of the Contract Times, resulting in a date for Substantial Completion of _____ ; and the number of days to achieve readiness for final payment is ___ consecutive calendar days from the commencement date of the Contract Times, resulting in a date for readiness for final payment of _____ .

Before starting any Work at the Site, Contractor must comply with the following:

Paragraph 2.01 of the General Conditions provides that you and Owner must each deliver to the other (with copies to Engineer and other identified additional insureds and loss payees) certificates of insurance which each is required to purchase and maintain in accordance with the Contract Documents.

Owner:	City of Marianna
By *(signature)*:	
Name *(printed)*:	William H. Long
Title:	City Manager
Date Issued:	

Copy: Engineer

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PERFORMANCE BOND

Contractor	**Surety**
Name: _____	Name: _____
Address *(principal place of business)*:	Address *(principal place of business)*:
_____	_____
_____	_____
Owner	**Contract**
Name: _____	Description *(name and location)*:
Mailing address *(principal place of business)*:	_____
_____	_____
_____	_____
_____	Contract Price: _____
	Effective Date of Contract:

Bond

Bond Amount:

Date of Bond:

(Date of Bond cannot be earlier than Effective Date of Contract)

Modifications to this Bond form:

☐ None ☐ See Paragraph 16

Surety and Contractor, intending to be legally bound hereby, subject to the terms set forth in this Performance Bond, do each cause this Performance Bond to be duly executed by an authorized officer, agent, or representative.

Contractor as Principal	Surety
_____	_____
(Full formal name of Contractor)	*(Full formal name of Surety) (corporate seal)*
By: _____	By: _____
(Signature)	*(Signature)(Attach Power of Attorney)*
Name: _____	Name: _____
(Printed or typed)	*(Printed or typed)*
Title: _____	Title: _____
Attest: _____	Attest: _____
(Signature)	*(Signature)*
Name: _____	Name: _____
(Printed or typed)	*(Printed or typed)*
Title: _____	Title: _____

Notes: (1) Provide supplemental execution by any additional parties, such as joint venturers. (2) Any singular reference to Contractor, Surety, Owner, or other party is considered plural where applicable.

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1. The Contractor and Surety, jointly and severally, bind themselves, their heirs, executors, administrators, successors, and assigns to the Owner for the performance of the Construction Contract, which is incorporated herein by reference.

2. If the Contractor performs the Construction Contract, the Surety and the Contractor shall have no obligation under this Bond, except when applicable to participate in a conference as provided in Paragraph 3.

3. If there is no Owner Default under the Construction Contract, the Surety's obligation under this Bond will arise after:

    3.1. The Owner first provides notice to the Contractor and the Surety that the Owner is considering declaring a Contractor Default. Such notice may indicate whether the Owner is requesting a conference among the Owner, Contractor, and Surety to discuss the Contractor's performance. If the Owner does not request a conference, the Surety may, within five (5) business days after receipt of the Owner's notice, request such a conference. If the Surety timely requests a conference, the Owner shall attend. Unless the Owner agrees otherwise, any conference requested under this Paragraph 3.1 will be held within ten (10) business days of the Surety's receipt of the Owner's notice. If the Owner, the Contractor, and the Surety agree, the Contractor shall be allowed a reasonable time to perform the Construction Contract, but such an agreement does not waive the Owner's right, if any, subsequently to declare a Contractor Default;

    3.2. The Owner declares a Contractor Default, terminates the Construction Contract and notifies the Surety; and

    3.3. The Owner has agreed to pay the Balance of the Contract Price in accordance with the terms of the Construction Contract to the Surety or to a contractor selected to perform the Construction Contract.

4. Failure on the part of the Owner to comply with the notice requirement in Paragraph 3.1 does not constitute a failure to comply with a condition precedent to the Surety's obligations, or release the Surety from its obligations, except to the extent the Surety demonstrates actual prejudice.

5. When the Owner has satisfied the conditions of Paragraph 3, the Surety shall promptly and at the Surety's expense take one of the following actions:

    5.1. Arrange for the Contractor, with the consent of the Owner, to perform and complete the Construction Contract;

    5.2. Undertake to perform and complete the Construction Contract itself, through its agents or independent contractors;

    5.3. Obtain bids or negotiated proposals from qualified contractors acceptable to the Owner for a contract for performance and completion of the Construction Contract, arrange for a contract to be prepared for execution by the Owner and a contractor selected with the Owners concurrence, to be secured with performance and payment bonds executed by a qualified surety equivalent to the bonds issued on the Construction Contract, and pay to the Owner the amount of damages as described in Paragraph 7 in excess of the Balance of the Contract Price incurred by the Owner as a result of the Contractor Default; or

    5.4. Waive its right to perform and complete, arrange for completion, or obtain a new contractor, and with reasonable promptness under the circumstances:

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5.4.1 After investigation, determine the amount for which it may be liable to the Owner and, as soon as practicable after the amount is determined, make payment to the Owner; or

5.4.2 Deny liability in whole or in part and notify the Owner, citing the reasons for denial.

6. If the Surety does not proceed as provided in Paragraph 5 with reasonable promptness, the Surety shall be deemed to be in default on this Bond seven days after receipt of an additional written notice from the Owner to the Surety demanding that the Surety perform its obligations under this Bond, and the Owner shall be entitled to enforce any remedy available to the Owner. If the Surety proceeds as provided in Paragraph 5.4, and the Owner refuses the payment, or the Surety has denied liability, in whole or in part, without further notice, the Owner shall be entitled to enforce any remedy available to the Owner.

7. If the Surety elects to act under Paragraph 5.1, 5.2, or 5.3, then the responsibilities of the Surety to the Owner will not be greater than those of the Contractor under the Construction Contract, and the responsibilities of the Owner to the Surety will not be greater than those of the Owner under the Construction Contract. Subject to the commitment by the Owner to pay the Balance of the Contract Price, the Surety is obligated, without duplication for:

   7.1. the responsibilities of the Contractor for correction of defective work and completion of the Construction Contract;

   7.2. additional legal, design professional, and delay costs resulting from the Contractor's Default, and resulting from the actions or failure to act of the Surety under Paragraph 5; and

   7.3. liquidated damages, or if no liquidated damages are specified in the Construction Contract, actual damages caused by delayed performance or non-performance of the Contractor.

8. If the Surety elects to act under Paragraph 5.1, 5.3, or 5.4, the Surety's liability is limited to the amount of this Bond.

9. The Surety shall not be liable to the Owner or others for obligations of the Contractor that are unrelated to the Construction Contract, and the Balance of the Contract Price will not be reduced or set off on account of any such unrelated obligations. No right of action will accrue on this Bond to any person or entity other than the Owner or its heirs, executors, administrators, successors, and assigns.

10. The Surety hereby waives notice of any change, including changes of time, to the Construction Contract or to related subcontracts, purchase orders, and other obligations.

11. Any proceeding, legal or equitable, under this Bond must be instituted in any court of competent jurisdiction in the location in which the work or part of the work is located and must be instituted within two years after a declaration of Contractor Default or within two years after the Contractor ceased working or within two years after the Surety refuses or fails to perform its obligations under this Bond, whichever occurs first. If the provisions of this paragraph are void or prohibited by law, the minimum periods of limitations available to sureties as a defense in the jurisdiction of the suit will be applicable.

12. Notice to the Surety, the Owner, or the Contractor must be mailed or delivered to the address shown on the page on which their signature appears.

13. When this Bond has been furnished to comply with a statutory or other legal requirement in the location where the construction was to be performed, any provision in this Bond conflicting with said statutory or legal requirement will be deemed deleted therefrom and provisions conforming to such

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statutory or other legal requirement will be deemed incorporated herein. When so furnished, the intent is that this Bond will be construed as a statutory bond and not as a common law bond.

14. Definitions

    14.1. *Balance of the Contract Price*—The total amount payable by the Owner to the Contractor under the Construction Contract after all proper adjustments have been made including allowance for the Contractor for any amounts received or to be received by the Owner in settlement of insurance or other claims for damages to which the Contractor is entitled, reduced by all valid and proper payments made to or on behalf of the Contractor under the Construction Contract.

    14.2. *Construction Contract*—The agreement between the Owner and Contractor identified on the cover page, including all Contract Documents and changes made to the agreement and the Contract Documents.

    14.3. *Contractor Default*—Failure of the Contractor, which has not been remedied or waived, to perform or otherwise to comply with a material term of the Construction Contract.

    14.4. *Owner Default*—Failure of the Owner, which has not been remedied or waived, to pay the Contractor as required under the Construction Contract or to perform and complete or comply with the other material terms of the Construction Contract.

    14.5. *Contract Documents*—All the documents that comprise the agreement between the Owner and Contractor.

15. If this Bond is issued for an agreement between a contractor and subcontractor, the term Contractor in this Bond will be deemed to be Subcontractor and the term Owner will be deemed to be Contractor.

16. Modifications to this Bond are as follows:

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PAYMENT BOND

Contractor	**Surety**
Name: _____	Name: _____
Address *(principal place of business)*:	Address *(principal place of business)*:
_____	_____
_____	_____
Owner	**Contract**
Name: _____	Description *(name and location)*:
Mailing address *(principal place of business)*:	_____
_____	_____
_____	Contract Price: _____
_____	Effective Date of Contract:
_____	

Bond

Bond Amount:

Date of Bond:

(Date of Bond cannot be earlier than Effective Date of Contract)

Modifications to this Bond form:

☐ None ☐ See Paragraph 18

Surety and Contractor, intending to be legally bound hereby, subject to the terms set forth in this Payment Bond, do each cause this Payment Bond to be duly executed by an authorized officer, agent, or representative.

Contractor as Principal	Surety
_____	_____
(Full formal name of Contractor)	*(Full formal name of Surety) (corporate seal)*
By: _____	By: _____
(Signature)	*(Signature)(Attach Power of Attorney)*
Name: _____	Name: _____
(Printed or typed)	*(Printed or typed)*
Title: _____	Title: _____
Attest: _____	Attest: _____
(Signature)	*(Signature)*
Name: _____	Name: _____
(Printed or typed)	*(Printed or typed)*
Title: _____	Title: _____

Notes: (1) Provide supplemental execution by any additional parties, such as joint venturers. (2) Any singular reference to Contractor, Surety, Owner, or other party is considered plural where applicable.

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1. The Contractor and Surety, jointly and severally, bind themselves, their heirs, executors, administrators, successors, and assigns to the Owner to pay for labor, materials, and equipment furnished for use in the performance of the Construction Contract, which is incorporated herein by reference, subject to the following terms.
2. If the Contractor promptly makes payment of all sums due to Claimants, and defends, indemnifies, and holds harmless the Owner from claims, demands, liens, or suits by any person or entity seeking payment for labor, materials, or equipment furnished for use in the performance of the Construction Contract, then the Surety and the Contractor shall have no obligation under this Bond.
3. If there is no Owner Default under the Construction Contract, the Surety's obligation to the Owner under this Bond will arise after the Owner has promptly notified the Contractor and the Surety (at the address described in Paragraph 13) of claims, demands, liens, or suits against the Owner or the Owner's property by any person or entity seeking payment for labor, materials, or equipment furnished for use in the performance of the Construction Contract, and tendered defense of such claims, demands, liens, or suits to the Contractor and the Surety.
4. When the Owner has satisfied the conditions in Paragraph 3, the Surety shall promptly and at the Surety's expense defend, indemnify, and hold harmless the Owner against a duly tendered claim, demand, lien, or suit.
5. The Surety's obligations to a Claimant under this Bond will arise after the following:
    5.1. Claimants who do not have a direct contract with the Contractor
        5.1.1. have furnished a written notice of non-payment to the Contractor, stating with substantial accuracy the amount claimed and the name of the party to whom the materials were, or equipment was, furnished or supplied or for whom the labor was done or performed, within ninety (90) days after having last performed labor or last furnished materials or equipment included in the Claim; and
        5.1.2. have sent a Claim to the Surety (at the address described in Paragraph 13).
    5.2. Claimants who are employed by or have a direct contract with the Contractor have sent a Claim to the Surety (at the address described in Paragraph 13).
6. If a notice of non-payment required by Paragraph 5.1.1 is given by the Owner to the Contractor, that is sufficient to satisfy a Claimant's obligation to furnish a written notice of non-payment under Paragraph 5.1.1.
7. When a Claimant has satisfied the conditions of Paragraph 5.1 or 5.2, whichever is applicable, the Surety shall promptly and at the Surety's expense take the following actions:
    7.1. Send an answer to the Claimant, with a copy to the Owner, within sixty (60) days after receipt of the Claim, stating the amounts that are undisputed and the basis for challenging any amounts that are disputed; and
    7.2. Pay or arrange for payment of any undisputed amounts.
    7.3. The Surety's failure to discharge its obligations under Paragraph 7.1 or 7.2 will not be deemed to constitute a waiver of defenses the Surety or Contractor may have or acquire as to a Claim, except as to undisputed amounts for which the Surety and Claimant have reached agreement. If, however, the Surety fails to discharge its obligations under Paragraph 7.1 or 7.2, the Surety shall indemnify the Claimant for the reasonable attorney's fees the Claimant incurs thereafter to recover any sums found to be due and owing to the Claimant.

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8. The Surety's total obligation will not exceed the amount of this Bond, plus the amount of reasonable attorney's fees provided under Paragraph 7.3, and the amount of this Bond will be credited for any payments made in good faith by the Surety.

9. Amounts owed by the Owner to the Contractor under the Construction Contract will be used for the performance of the Construction Contract and to satisfy claims, if any, under any construction performance bond. By the Contractor furnishing and the Owner accepting this Bond, they agree that all funds earned by the Contractor in the performance of the Construction Contract are dedicated to satisfying obligations of the Contractor and Surety under this Bond, subject to the Owner's priority to use the funds for the completion of the work.

10. The Surety shall not be liable to the Owner, Claimants, or others for obligations of the Contractor that are unrelated to the Construction Contract. The Owner shall not be liable for the payment of any costs or expenses of any Claimant under this Bond, and shall have under this Bond no obligation to make payments to or give notice on behalf of Claimants, or otherwise have any obligations to Claimants under this Bond.

11. The Surety hereby waives notice of any change, including changes of time, to the Construction Contract or to related subcontracts, purchase orders, and other obligations.

12. No suit or action will be commenced by a Claimant under this Bond other than in a court of competent jurisdiction in the state in which the project that is the subject of the Construction Contract is located or after the expiration of one year from the date (1) on which the Claimant sent a Claim to the Surety pursuant to Paragraph 5.1.2 or 5.2, or (2) on which the last labor or service was performed by anyone or the last materials or equipment were furnished by anyone under the Construction Contract, whichever of (1) or (2) first occurs. If the provisions of this paragraph are void or prohibited by law, the minimum period of limitation available to sureties as a defense in the jurisdiction of the suit will be applicable.

13. Notice and Claims to the Surety, the Owner, or the Contractor must be mailed or delivered to the address shown on the page on which their signature appears. Actual receipt of notice or Claims, however accomplished, will be sufficient compliance as of the date received.

14. When this Bond has been furnished to comply with a statutory or other legal requirement in the location where the construction was to be performed, any provision in this Bond conflicting with said statutory or legal requirement will be deemed deleted here from and provisions conforming to such statutory or other legal requirement will be deemed incorporated herein. When so furnished, the intent is that this Bond will be construed as a statutory bond and not as a common law bond.

15. Upon requests by any person or entity appearing to be a potential beneficiary of this Bond, the Contractor and Owner shall promptly furnish a copy of this Bond or shall permit a copy to be made.

16. Definitions

    16.1. *Claim*—A written statement by the Claimant including at a minimum:

        16.1.1. The name of the Claimant;

        16.1.2. The name of the person for whom the labor was done, or materials or equipment furnished;

        16.1.3. A copy of the agreement or purchase order pursuant to which labor, materials, or equipment was furnished for use in the performance of the Construction Contract;

        16.1.4. A brief description of the labor, materials, or equipment furnished;

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16.1.5. The date on which the Claimant last performed labor or last furnished materials or equipment for use in the performance of the Construction Contract;

16.1.6. The total amount earned by the Claimant for labor, materials, or equipment furnished as of the date of the Claim;

16.1.7. The total amount of previous payments received by the Claimant; and

16.1.8. The total amount due and unpaid to the Claimant for labor, materials, or equipment furnished as of the date of the Claim.

16.2. *Claimant*—An individual or entity having a direct contract with the Contractor or with a subcontractor of the Contractor to furnish labor, materials, or equipment for use in the performance of the Construction Contract. The term Claimant also includes any individual or entity that has rightfully asserted a claim under an applicable mechanic's lien or similar statute against the real property upon which the Project is located. The intent of this Bond is to include without limitation in the terms of "labor, materials, or equipment" that part of the water, gas, power, light, heat, oil, gasoline, telephone service, or rental equipment used in the Construction Contract, architectural and engineering services required for performance of the work of the Contractor and the Contractor's subcontractors, and all other items for which a mechanic's lien may be asserted in the jurisdiction where the labor, materials, or equipment were furnished.

16.3. *Construction Contract*—The agreement between the Owner and Contractor identified on the cover page, including all Contract Documents and all changes made to the agreement and the Contract Documents.

16.4. *Owner Default*—Failure of the Owner, which has not been remedied or waived, to pay the Contractor as required under the Construction Contract or to perform and complete or comply with the other material terms of the Construction Contract.

16.5. *Contract Documents*—All the documents that comprise the agreement between the Owner and Contractor.

17. If this Bond is issued for an agreement between a contractor and subcontractor, the term Contractor in this Bond will be deemed to be Subcontractor and the term Owner will be deemed to be Contractor.

18. Modifications to this Bond are as follows:

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CERTIFICATE OF SUBSTANTIAL COMPLETION

Owner:
Engineer:
Contractor:
Project:
Contract Name:

Owner's Project No.:
Engineer's Project No.:
Contractor's Project No.:

This ☐ Preliminary ☐ Final Certificate of Substantial Completion applies to:

☐ All Work ☐ The following specified portions of the Work:

Date of Substantial Completion:

The Work to which this Certificate applies has been inspected by authorized representatives of Owner, Contractor, and Engineer, and found to be substantially complete. The Date of Substantial Completion of the Work or portion thereof designated above is hereby established, subject to the provisions of the Contract pertaining to Substantial Completion. The date of Substantial Completion in the final Certificate of Substantial Completion marks the commencement of the contractual correction period and applicable warranties required by the Contract.

A punch list of items to be completed or corrected is attached to this Certificate. This list may not be all-inclusive, and the failure to include any items on such list does not alter the responsibility of the Contractor to complete all Work in accordance with the Contract Documents.

Amendments of contractual responsibilities recorded in this Certificate should be the product of mutual agreement of Owner and Contractor; see Paragraph 15.03.D of the General Conditions.

The responsibilities between Owner and Contractor for security, operation, safety, maintenance, heat, utilities, insurance, and warranties upon Owner's use or occupancy of the Work must be as provided in the Contract, except as amended as follows:

Amendments to Owner's Responsibilities: ☐ None ☐ As follows:

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Amendments to Contractor's Responsibilities: ☐ None ☐ As follows:

The following documents are attached to and made a part of this Certificate:

This Certificate does not constitute an acceptance of Work not in accordance with the Contract Documents, nor is it a release of Contractor's obligation to complete the Work in accordance with the Contract Documents.

Engineer

By *(signature)*:

Name *(printed)*:

Title:

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NOTICE OF ACCEPTABILITY OF WORK

Owner:	Owner's Project No.:
Engineer:	Engineer's Project No.:
Contractor:	Contractor's Project No.:
Project:	
Contract Name:	
Notice Date:	Effective Date of the Construction Contract:

The Engineer hereby gives notice to the Owner and Contractor that Engineer recommends final payment to Contractor, and that the Work furnished and performed by Contractor under the Construction Contract is acceptable, expressly subject to the provisions of the Construction Contract's Contract Documents ("Contract Documents") and of the Agreement between Owner and Engineer for Professional Services dated _____ ("Owner-Engineer Agreement"). This Notice of Acceptability of Work (Notice) is made expressly subject to the following terms and conditions to which all who receive and rely on said Notice agree:

1. This Notice has been prepared with the skill and care ordinarily used by members of the engineering profession practicing under similar conditions at the same time and in the same locality.
2. This Notice reflects and is an expression of the Engineer's professional opinion.
3. This Notice has been prepared to the best of Engineer's knowledge, information, and belief as of the Notice Date.
4. This Notice is based entirely on and expressly limited by the scope of services Engineer has been employed by Owner to perform or furnish during construction of the Project (including observation of the Contractor's Work) under the Owner-Engineer Agreement, and applies only to facts that are within Engineer's knowledge or could reasonably have been ascertained by Engineer as a result of carrying out the responsibilities specifically assigned to Engineer under such Owner-Engineer Agreement.
5. This Notice is not a guarantee or warranty of Contractor's performance under the Construction Contract, an acceptance of Work that is not in accordance with the Contract Documents, including but not limited to defective Work discovered after final inspection, nor an assumption of responsibility for any failure of Contractor to furnish and perform the Work thereunder in accordance with the Contract Documents, or to otherwise comply with the Contract Documents or the terms of any special guarantees specified therein.
6. This Notice does not relieve Contractor of any surviving obligations under the Construction Contract, and is subject to Owner's reservations of rights with respect to completion and final payment.

Engineer

By *(signature)*: _____

Name *(printed)*: _____

Title: _____

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CERTIFICATE OF FINAL COMPLETION

Owner:	Owner's Contract No.:
Contractor:	Contractor's Project No.:
Engineer:	Engineer's Project No.:
Project:	Contract Name:

This [preliminary] [final] Certificate of Final Completion applies to:

☐ All Work under the Contract Documents or to the following specified parts thereof:

The Work to which this Certificate applies has been inspected by authorized representatives of Owner, Contractor, and Engineer, and found to be complete in accordance with the Contract Documents on

_____

Date of Final Completion

Notice to Proceed: _____(DATE)

Notice Contract Time: _____(CALENDAR DAYS)

Additional Contract Time
Approved by Change Order: _____(CALENDAR DAYS)

Total Approved Contract Time: _____(CALENDAR DAYS)

Actual Contract Time: _____(CALENDAR DAYS)

Unapproved Construction Time: _____(CALENDAR DAYS)

A warranty inspection will be held on: _____

The Warranty will expire on: _____

_____

The following documents are attached to and made a part of this Certificate: _____

_____

This certificate constitutes an acceptance of work in accordance with the Contract Documents. However, this certification shall not release the Contractor or its sureties from any obligations under the Contract Documents. The Performance Bond remains in full force and effect through the one (1) year warranty period.

EXECUTED BY ENGINEER:	RECEIVED:	RECEIVED:
By: _____ (Authorized signature)	By: _____ Owner (Authorized Signature)	By: _____ Contractor (Authorized Signature)
Title: _____	Title: _____	Title: _____
Date: _____	Date: _____	Date: _____

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STANDARD GENERAL CONDITIONS OF THE CONSTRUCTION CONTRACT

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STANDARD GENERAL CONDITIONS OF THE CONSTRUCTION CONTRACT

ARTICLE 1—DEFINITIONS AND TERMINOLOGY

1.01 *Defined Terms*

A. Wherever used in the Bidding Requirements or Contract Documents, a term printed with initial capital letters, including the term's singular and plural forms, will have the meaning indicated in the definitions below. In addition to terms specifically defined, terms with initial capital letters in the Contract Documents include references to identified articles and paragraphs, and the titles of other documents or forms.

1. *Addenda*—Written or graphic instruments issued prior to the opening of Bids which clarify, correct, or change the Bidding Requirements or the proposed Contract Documents.

2. *Agreement*—The written instrument, executed by Owner and Contractor, that sets forth the Contract Price and Contract Times, identifies the parties and the Engineer, and designates the specific items that are Contract Documents.

3. *Application for Payment*—The document prepared by Contractor, in a form acceptable to Engineer, to request progress or final payments, and which is to be accompanied by such supporting documentation as is required by the Contract Documents.

4. *Bid*—The offer of a Bidder submitted on the prescribed form setting forth the prices for the Work to be performed.

5. *Bidder*—An individual or entity that submits a Bid to Owner.

6. *Bidding Documents*—The Bidding Requirements, the proposed Contract Documents, and all Addenda.

7. *Bidding Requirements*—The Advertisement or invitation to bid, Instructions to Bidders, Bid Bond or other Bid security, if any, the Bid Form, and the Bid with any attachments.

8. *Change Order*—A document which is signed by Contractor and Owner and authorizes an addition, deletion, or revision in the Work or an adjustment in the Contract Price or the Contract Times, or other revision to the Contract, issued on or after the Effective Date of the Contract.

9. *Change Proposal*—A written request by Contractor, duly submitted in compliance with the procedural requirements set forth herein, seeking an adjustment in Contract Price or Contract Times; contesting an initial decision by Engineer concerning the requirements of the Contract Documents or the acceptability of Work under the Contract Documents; challenging a set-off against payments due; or seeking other relief with respect to the terms of the Contract.

10. *Claim*

a. A demand or assertion by Owner directly to Contractor, duly submitted in compliance with the procedural requirements set forth herein, seeking an adjustment of Contract Price or Contract Times; contesting an initial decision by Engineer concerning the

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requirements of the Contract Documents or the acceptability of Work under the Contract Documents; contesting Engineer's decision regarding a Change Proposal; seeking resolution of a contractual issue that Engineer has declined to address; or seeking other relief with respect to the terms of the Contract.

b. A demand or assertion by Contractor directly to Owner, duly submitted in compliance with the procedural requirements set forth herein, contesting Engineer's decision regarding a Change Proposal, or seeking resolution of a contractual issue that Engineer has declined to address.

c. A demand or assertion by Owner or Contractor, duly submitted in compliance with the procedural requirements set forth herein, made pursuant to Paragraph 12.01.A.4, concerning disputes arising after Engineer has issued a recommendation of final payment.

d. A demand for money or services by a third party is not a Claim.

11. *Constituent of Concern*—Asbestos, petroleum, radioactive materials, polychlorinated biphenyls (PCBs), lead-based paint (as defined by the HUD/EPA standard), hazardous waste, and any substance, product, waste, or other material of any nature whatsoever that is or becomes listed, regulated, or addressed pursuant to Laws and Regulations regulating, relating to, or imposing liability or standards of conduct concerning, any hazardous, toxic, or dangerous waste, substance, or material.

12. *Contract*—The entire and integrated written contract between Owner and Contractor concerning the Work.

13. *Contract Documents*—Those items so designated in the Agreement, and which together comprise the Contract.

14. *Contract Price*—The money that Owner has agreed to pay Contractor for completion of the Work in accordance with the Contract Documents.

15. *Contract Times*—The number of days or the dates by which Contractor shall: (a) achieve Milestones, if any; (b) achieve Substantial Completion; and (c) complete the Work.

16. *Contractor*—The individual or entity with which Owner has contracted for performance of the Work.

17. *Cost of the Work*—See Paragraph 13.01 for definition.

18. *Drawings*—The part of the Contract that graphically shows the scope, extent, and character of the Work to be performed by Contractor.

19. *Effective Date of the Contract*—The date, indicated in the Agreement, on which the Contract becomes effective.

20. *Electronic Document*—Any Project-related correspondence, attachments to correspondence, data, documents, drawings, information, or graphics, including but not limited to Shop Drawings and other Submittals, that are in an electronic or digital format.

21. *Electronic Means*—Electronic mail (email), upload/download from a secure Project website, or other communications methods that allow: (a) the transmission or communication of Electronic Documents; (b) the documentation of transmissions, including sending and receipt; (c) printing of the transmitted Electronic Document by the

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recipient; (d) the storage and archiving of the Electronic Document by sender and recipient; and (e) the use by recipient of the Electronic Document for purposes permitted by this Contract. Electronic Means does not include the use of text messaging, or of Facebook, Twitter, Instagram, or similar social media services for transmission of Electronic Documents.

22. *Engineer*—The individual or entity named as such in the Agreement.

23. *Field Order*—A written order issued by Engineer which requires minor changes in the Work but does not change the Contract Price or the Contract Times.

24. *Hazardous Environmental Condition*—The presence at the Site of Constituents of Concern in such quantities or circumstances that may present a danger to persons or property exposed thereto.

    a. The presence at the Site of materials that are necessary for the execution of the Work, or that are to be incorporated into the Work, and that are controlled and contained pursuant to industry practices, Laws and Regulations, and the requirements of the Contract, is not a Hazardous Environmental Condition.

    b. The presence of Constituents of Concern that are to be removed or remediated as part of the Work is not a Hazardous Environmental Condition.

    c. The presence of Constituents of Concern as part of the routine, anticipated, and obvious working conditions at the Site, is not a Hazardous Environmental Condition.

25. *Laws and Regulations; Laws or Regulations*—Any and all applicable laws, statutes, rules, regulations, ordinances, codes, and binding decrees, resolutions, and orders of any and all governmental bodies, agencies, authorities, and courts having jurisdiction.

26. *Liens*—Charges, security interests, or encumbrances upon Contract-related funds, real property, or personal property.

27. *Milestone*—A principal event in the performance of the Work that the Contract requires Contractor to achieve by an intermediate completion date, or by a time prior to Substantial Completion of all the Work.

28. *Notice of Award*—The written notice by Owner to a Bidder of Owner's acceptance of the Bid.

29. *Notice to Proceed*—A written notice by Owner to Contractor fixing the date on which the Contract Times will commence to run and on which Contractor shall start to perform the Work.

30. *Owner*—The individual or entity with which Contractor has contracted regarding the Work, and which has agreed to pay Contractor for the performance of the Work, pursuant to the terms of the Contract.

31. *Progress Schedule*—A schedule, prepared and maintained by Contractor, describing the sequence and duration of the activities comprising Contractor's plan to accomplish the Work within the Contract Times.

32. *Project*—The total undertaking to be accomplished for Owner by engineers, contractors, and others, including planning, study, design, construction, testing, commissioning, and start-up, and of which the Work to be performed under the Contract Documents is a part.

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33. *Resident Project Representative*—The authorized representative of Engineer assigned to assist Engineer at the Site. As used herein, the term Resident Project Representative (RPR) includes any assistants or field staff of Resident Project Representative.

34. *Samples*—Physical examples of materials, equipment, or workmanship that are representative of some portion of the Work and that establish the standards by which such portion of the Work will be judged.

35. *Schedule of Submittals*—A schedule, prepared and maintained by Contractor, of required submittals and the time requirements for Engineer's review of the submittals.

36. *Schedule of Values*—A schedule, prepared and maintained by Contractor, allocating portions of the Contract Price to various portions of the Work and used as the basis for reviewing Contractor's Applications for Payment.

37. *Shop Drawings*—All drawings, diagrams, illustrations, schedules, and other data or information that are specifically prepared or assembled by or for Contractor and submitted by Contractor to illustrate some portion of the Work. Shop Drawings, whether approved or not, are not Drawings and are not Contract Documents.

38. *Site*—Lands or areas indicated in the Contract Documents as being furnished by Owner upon which the Work is to be performed, including rights-of-way and easements, and such other lands or areas furnished by Owner which are designated for the use of Contractor.

39. *Specifications*—The part of the Contract that consists of written requirements for materials, equipment, systems, standards, and workmanship as applied to the Work, and certain administrative requirements and procedural matters applicable to the Work.

40. *Subcontractor*—An individual or entity having a direct contract with Contractor or with any other Subcontractor for the performance of a part of the Work.

41. *Submittal*—A written or graphic document, prepared by or for Contractor, which the Contract Documents require Contractor to submit to Engineer, or that is indicated as a Submittal in the Schedule of Submittals accepted by Engineer. Submittals may include Shop Drawings and Samples; schedules; product data; Owner-delegated designs; sustainable design information; information on special procedures; testing plans; results of tests and evaluations, source quality-control testing and inspections, and field or Site quality-control testing and inspections; warranties and certifications; Suppliers' instructions and reports; records of delivery of spare parts and tools; operations and maintenance data; Project photographic documentation; record documents; and other such documents required by the Contract Documents. Submittals, whether or not approved or accepted by Engineer, are not Contract Documents. Change Proposals, Change Orders, Claims, notices, Applications for Payment, and requests for interpretation or clarification are not Submittals.

42. *Substantial Completion*—The time at which the Work (or a specified part thereof) has progressed to the point where, in the opinion of Engineer, the Work (or a specified part thereof) is sufficiently complete, in accordance with the Contract Documents, so that the Work (or a specified part thereof) can be utilized for the purposes for which it is intended. The terms "substantially complete" and "substantially completed" as applied to all or part of the Work refer to Substantial Completion of such Work.

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43. *Successful Bidder*—The Bidder to which the Owner makes an award of contract.

44. *Supplementary Conditions*—The part of the Contract that amends or supplements these General Conditions.

45. *Supplier*—A manufacturer, fabricator, supplier, distributor, or vendor having a direct contract with Contractor or with any Subcontractor to furnish materials or equipment to be incorporated in the Work by Contractor or a Subcontractor.

46. *Technical Data*

    a. Those items expressly identified as Technical Data in the Supplementary Conditions, with respect to either (1) existing subsurface conditions at or adjacent to the Site, or existing physical conditions at or adjacent to the Site including existing surface or subsurface structures (except Underground Facilities) or (2) Hazardous Environmental Conditions at the Site.

    b. If no such express identifications of Technical Data have been made with respect to conditions at the Site, then Technical Data is defined, with respect to conditions at the Site under Paragraphs 5.03, 5.04, and 5.06, as the data contained in boring logs, recorded measurements of subsurface water levels, assessments of the condition of subsurface facilities, laboratory test results, and other factual, objective information regarding conditions at the Site that are set forth in any geotechnical, environmental, or other Site or facilities conditions report prepared for the Project and made available to Contractor.

    c. Information and data regarding the presence or location of Underground Facilities are not intended to be categorized, identified, or defined as Technical Data, and instead Underground Facilities are shown or indicated on the Drawings.

47. *Underground Facilities*—All active or not-in-service underground lines, pipelines, conduits, ducts, encasements, cables, wires, manholes, vaults, tanks, tunnels, or other such facilities or systems at the Site, including but not limited to those facilities or systems that produce, transmit, distribute, or convey telephone or other communications, cable television, fiber optic transmissions, power, electricity, light, heat, gases, oil, crude oil products, liquid petroleum products, water, steam, waste, wastewater, storm water, other liquids or chemicals, or traffic or other control systems. An abandoned facility or system is not an Underground Facility.

48. *Unit Price Work*—Work to be paid for on the basis of unit prices.

49. *Work*—The entire construction or the various separately identifiable parts thereof required to be provided under the Contract Documents. Work includes and is the result of performing or providing all labor, services, and documentation necessary to produce such construction; furnishing, installing, and incorporating all materials and equipment into such construction; and may include related services such as testing, start-up, and commissioning, all as required by the Contract Documents.

50. *Work Change Directive*—A written directive to Contractor issued on or after the Effective Date of the Contract, signed by Owner and recommended by Engineer, ordering an addition, deletion, or revision in the Work.

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1.02 *Terminology*

A. The words and terms discussed in Paragraphs 1.02.B, C, D, and E are not defined terms that require initial capital letters, but, when used in the Bidding Requirements or Contract Documents, have the indicated meaning.

B. *Intent of Certain Terms or Adjectives*: The Contract Documents include the terms "as allowed," "as approved," "as ordered," "as directed" or terms of like effect or import to authorize an exercise of professional judgment by Engineer. In addition, the adjectives "reasonable," "suitable," "acceptable," "proper," "satisfactory," or adjectives of like effect or import are used to describe an action or determination of Engineer as to the Work. It is intended that such exercise of professional judgment, action, or determination will be solely to evaluate, in general, the Work for compliance with the information in the Contract Documents and with the design concept of the Project as a functioning whole as shown or indicated in the Contract Documents (unless there is a specific statement indicating otherwise). The use of any such term or adjective is not intended to and shall not be effective to assign to Engineer any duty or authority to supervise or direct the performance of the Work, or any duty or authority to undertake responsibility contrary to the provisions of Article 10 or any other provision of the Contract Documents.

C. *Day*: The word "day" means a calendar day of 24 hours measured from midnight to the next midnight.

D. *Defective*: The word "defective," when modifying the word "Work," refers to Work that is unsatisfactory, faulty, or deficient in that it:

1. does not conform to the Contract Documents;

2. does not meet the requirements of any applicable inspection, reference standard, test, or approval referred to in the Contract Documents; or

3. has been damaged prior to Engineer's recommendation of final payment (unless responsibility for the protection thereof has been assumed by Owner at Substantial Completion in accordance with Paragraph 15.03 or Paragraph 15.04).

E. *Furnish, Install, Perform, Provide*

1. The word "furnish," when used in connection with services, materials, or equipment, means to supply and deliver said services, materials, or equipment to the Site (or some other specified location) ready for use or installation and in usable or operable condition.

2. The word "install," when used in connection with services, materials, or equipment, means to put into use or place in final position said services, materials, or equipment complete and ready for intended use.

3. The words "perform" or "provide," when used in connection with services, materials, or equipment, means to furnish and install said services, materials, or equipment complete and ready for intended use.

4. If the Contract Documents establish an obligation of Contractor with respect to specific services, materials, or equipment, but do not expressly use any of the four words "furnish," "install," "perform," or "provide," then Contractor shall furnish and install said services, materials, or equipment complete and ready for intended use.

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F. *Contract Price or Contract Times*: References to a change in "Contract Price or Contract Times" or "Contract Times or Contract Price" or similar, indicate that such change applies to (1) Contract Price, (2) Contract Times, or (3) both Contract Price and Contract Times, as warranted, even if the term "or both" is not expressed.

G. Unless stated otherwise in the Contract Documents, words or phrases that have a well-known technical or construction industry or trade meaning are used in the Contract Documents in accordance with such recognized meaning.

ARTICLE 2—PRELIMINARY MATTERS

2.01 *Delivery of Performance and Payment Bonds; Evidence of Insurance*

A. *Performance and Payment Bonds*: When Contractor delivers the signed counterparts of the Agreement to Owner, Contractor shall also deliver to Owner the performance bond and payment bond (if the Contract requires Contractor to furnish such bonds).

B. *Evidence of Contractor's Insurance*: When Contractor delivers the signed counterparts of the Agreement to Owner, Contractor shall also deliver to Owner, with copies to each additional insured (as identified in the Contract), the certificates, endorsements, and other evidence of insurance required to be provided by Contractor in accordance with Article 6, except to the extent the Supplementary Conditions expressly establish other dates for delivery of specific insurance policies.

C. *Evidence of Owner's Insurance*: After receipt of the signed counterparts of the Agreement and all required bonds and insurance documentation, Owner shall promptly deliver to Contractor, with copies to each additional insured (as identified in the Contract), the certificates and other evidence of insurance required to be provided by Owner under Article 6.

2.02 *Copies of Documents*

A. Owner shall furnish to Contractor four printed copies of the Contract (including one fully signed counterpart of the Agreement), and one copy in electronic portable document format (PDF). Additional printed copies will be furnished upon request at the cost of reproduction.

B. Owner shall maintain and safeguard at least one original printed record version of the Contract, including Drawings and Specifications signed and sealed by Engineer and other design professionals. Owner shall make such original printed record version of the Contract available to Contractor for review. Owner may delegate the responsibilities under this provision to Engineer.

2.03 *Before Starting Construction*

A. *Preliminary Schedules*: Within 10 days after the Effective Date of the Contract (or as otherwise required by the Contract Documents), Contractor shall submit to Engineer for timely review:

1. a preliminary Progress Schedule indicating the times (numbers of days or dates) for starting and completing the various stages of the Work, including any Milestones specified in the Contract;

2. a preliminary Schedule of Submittals; and

3. a preliminary Schedule of Values for all of the Work which includes quantities and prices of items which when added together equal the Contract Price and subdivides the Work

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into component parts in sufficient detail to serve as the basis for progress payments during performance of the Work. Such prices will include an appropriate amount of overhead and profit applicable to each item of Work.

2.04 *Preconstruction Conference; Designation of Authorized Representatives*

A. Before any Work at the Site is started, a conference attended by Owner, Contractor, Engineer, and others as appropriate will be held to establish a working understanding among the parties as to the Work, and to discuss the schedules referred to in Paragraph 2.03.A, procedures for handling Shop Drawings, Samples, and other Submittals, processing Applications for Payment, electronic or digital transmittals, and maintaining required records.

B. At this conference Owner and Contractor each shall designate, in writing, a specific individual to act as its authorized representative with respect to the services and responsibilities under the Contract. Such individuals shall have the authority to transmit and receive information, render decisions relative to the Contract, and otherwise act on behalf of each respective party.

2.05 *Acceptance of Schedules*

A. At least 10 days before submission of the first Application for Payment a conference, attended by Contractor, Engineer, and others as appropriate, will be held to review the schedules submitted in accordance with Paragraph 2.03.A. No progress payment will be made to Contractor until acceptable schedules are submitted to Engineer.

1. The Progress Schedule will be acceptable to Engineer if it provides an orderly progression of the Work to completion within the Contract Times. Such acceptance will not impose on Engineer responsibility for the Progress Schedule, for sequencing, scheduling, or progress of the Work, nor interfere with or relieve Contractor from Contractor's full responsibility therefor.

2. Contractor's Schedule of Submittals will be acceptable to Engineer if it provides a workable arrangement for reviewing and processing the required submittals.

3. Contractor's Schedule of Values will be acceptable to Engineer as to form and substance if it provides a reasonable allocation of the Contract Price to the component parts of the Work.

4. If a schedule is not acceptable, Contractor will have an additional 10 days to revise and resubmit the schedule.

2.06 *Electronic Transmittals*

A. Except as otherwise stated elsewhere in the Contract, the Owner, Engineer, and Contractor may send, and shall accept, Electronic Documents transmitted by Electronic Means.

B. If the Contract does not establish protocols for Electronic Means, then Owner, Engineer, and Contractor shall jointly develop such protocols.

C. Subject to any governing protocols for Electronic Means, when transmitting Electronic Documents by Electronic Means, the transmitting party makes no representations as to long-term compatibility, usability, or readability of the Electronic Documents resulting from the recipient's use of software application packages, operating systems, or computer hardware differing from those used in the drafting or transmittal of the Electronic Documents.

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ARTICLE 3—CONTRACT DOCUMENTS: INTENT, REQUIREMENTS, REUSE

3.01 *Intent*

A. The Contract Documents are complementary; what is required by one Contract Document is as binding as if required by all.

B. It is the intent of the Contract Documents to describe a functionally complete Project (or part thereof) to be constructed in accordance with the Contract Documents.

C. Unless otherwise stated in the Contract Documents, if there is a discrepancy between the electronic versions of the Contract Documents (including any printed copies derived from such electronic versions) and the printed record version, the printed record version will govern.

D. The Contract supersedes prior negotiations, representations, and agreements, whether written or oral.

E. Engineer will issue clarifications and interpretations of the Contract Documents as provided herein.

F. Any provision or part of the Contract Documents held to be void or unenforceable under any Law or Regulation will be deemed stricken, and all remaining provisions will continue to be valid and binding upon Owner and Contractor, which agree that the Contract Documents will be reformed to replace such stricken provision or part thereof with a valid and enforceable provision that comes as close as possible to expressing the intention of the stricken provision.

G. Nothing in the Contract Documents creates:

1. any contractual relationship between Owner or Engineer and any Subcontractor, Supplier, or other individual or entity performing or furnishing any of the Work, for the benefit of such Subcontractor, Supplier, or other individual or entity; or

2. any obligation on the part of Owner or Engineer to pay or to see to the payment of any money due any such Subcontractor, Supplier, or other individual or entity, except as may otherwise be required by Laws and Regulations.

3.02 *Reference Standards*

A. *Standards Specifications, Codes, Laws and Regulations*

1. Reference in the Contract Documents to standard specifications, manuals, reference standards, or codes of any technical society, organization, or association, or to Laws or Regulations, whether such reference be specific or by implication, means the standard specification, manual, reference standard, code, or Laws or Regulations in effect at the time of opening of Bids (or on the Effective Date of the Contract if there were no Bids), except as may be otherwise specifically stated in the Contract Documents.

2. No provision of any such standard specification, manual, reference standard, or code, and no instruction of a Supplier, will be effective to change the duties or responsibilities of Owner, Contractor, or Engineer from those set forth in the part of the Contract Documents prepared by or for Engineer. No such provision or instruction shall be effective to assign to Owner or Engineer any duty or authority to supervise or direct the performance of the Work, or any duty or authority to undertake responsibility

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inconsistent with the provisions of the part of the Contract Documents prepared by or for Engineer.

3.03 *Reporting and Resolving Discrepancies*

A. *Reporting Discrepancies*

1. *Contractor's Verification of Figures and Field Measurements*: Before undertaking each part of the Work, Contractor shall carefully study the Contract Documents, and check and verify pertinent figures and dimensions therein, particularly with respect to applicable field measurements. Contractor shall promptly report in writing to Engineer any conflict, error, ambiguity, or discrepancy that Contractor discovers, or has actual knowledge of, and shall not proceed with any Work affected thereby until the conflict, error, ambiguity, or discrepancy is resolved by a clarification or interpretation by Engineer, or by an amendment or supplement to the Contract issued pursuant to Paragraph 11.01.

2. *Contractor's Review of Contract Documents*: If, before or during the performance of the Work, Contractor discovers any conflict, error, ambiguity, or discrepancy within the Contract Documents, or between the Contract Documents and (a) any applicable Law or Regulation, (b) actual field conditions, (c) any standard specification, manual, reference standard, or code, or (d) any instruction of any Supplier, then Contractor shall promptly report it to Engineer in writing. Contractor shall not proceed with the Work affected thereby (except in an emergency as required by Paragraph 7.15) until the conflict, error, ambiguity, or discrepancy is resolved, by a clarification or interpretation by Engineer, or by an amendment or supplement to the Contract issued pursuant to Paragraph 11.01.

3. Contractor shall not be liable to Owner or Engineer for failure to report any conflict, error, ambiguity, or discrepancy in the Contract Documents unless Contractor had actual knowledge thereof.

B. *Resolving Discrepancies*

1. Except as may be otherwise specifically stated in the Contract Documents, the provisions of the part of the Contract Documents prepared by or for Engineer take precedence in resolving any conflict, error, ambiguity, or discrepancy between such provisions of the Contract Documents and:

a. the provisions of any standard specification, manual, reference standard, or code, or the instruction of any Supplier (whether or not specifically incorporated by reference as a Contract Document); or

b. the provisions of any Laws or Regulations applicable to the performance of the Work (unless such an interpretation of the provisions of the Contract Documents would result in violation of such Law or Regulation).

3.04 *Requirements of the Contract Documents*

A. During the performance of the Work and until final payment, Contractor and Owner shall submit to the Engineer in writing all matters in question concerning the requirements of the Contract Documents (sometimes referred to as requests for information or interpretation—RFIs), or relating to the acceptability of the Work under the Contract Documents, as soon as possible after such matters arise. Engineer will be the initial interpreter of the requirements of the Contract Documents, and judge of the acceptability of the Work.

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B. Engineer will, with reasonable promptness, render a written clarification, interpretation, or decision on the issue submitted, or initiate an amendment or supplement to the Contract Documents. Engineer's written clarification, interpretation, or decision will be final and binding on Contractor, unless it appeals by submitting a Change Proposal, and on Owner, unless it appeals by filing a Claim.

C. If a submitted matter in question concerns terms and conditions of the Contract Documents that do not involve (1) the performance or acceptability of the Work under the Contract Documents, (2) the design (as set forth in the Drawings, Specifications, or otherwise), or (3) other engineering or technical matters, then Engineer will promptly notify Owner and Contractor in writing that Engineer is unable to provide a decision or interpretation. If Owner and Contractor are unable to agree on resolution of such a matter in question, either party may pursue resolution as provided in Article 12.

3.05 *Reuse of Documents*

A. Contractor and its Subcontractors and Suppliers shall not:

1. have or acquire any title to or ownership rights in any of the Drawings, Specifications, or other documents (or copies of any thereof) prepared by or bearing the seal of Engineer or its consultants, including electronic media versions, or reuse any such Drawings, Specifications, other documents, or copies thereof on extensions of the Project or any other project without written consent of Owner and Engineer and specific written verification or adaptation by Engineer; or

2. have or acquire any title or ownership rights in any other Contract Documents, reuse any such Contract Documents for any purpose without Owner's express written consent, or violate any copyrights pertaining to such Contract Documents.

B. The prohibitions of this Paragraph 3.05 will survive final payment, or termination of the Contract. Nothing herein precludes Contractor from retaining copies of the Contract Documents for record purposes.

ARTICLE 4—COMMENCEMENT AND PROGRESS OF THE WORK

4.01 *Commencement of Contract Times; Notice to Proceed*

A. The Contract Times will commence to run on the 30th day after the Effective Date of the Contract or, if a Notice to Proceed is given, on the day indicated in the Notice to Proceed. A Notice to Proceed may be given at any time within 30 days after the Effective Date of the Contract. In no event will the Contract Times commence to run later than the 60th day after the day of Bid opening or the 30th day after the Effective Date of the Contract, whichever date is earlier.

4.02 *Starting the Work*

A. Contractor shall start to perform the Work on the date when the Contract Times commence to run. No Work may be done at the Site prior to such date.

4.03 *Reference Points*

A. Owner shall provide engineering surveys to establish reference points for construction which in Engineer's judgment are necessary to enable Contractor to proceed with the Work. Contractor shall be responsible for laying out the Work, shall protect and preserve the

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established reference points and property monuments, and shall make no changes or relocations without the prior written approval of Owner. Contractor shall report to Engineer whenever any reference point or property monument is lost or destroyed or requires relocation because of necessary changes in grades or locations, and shall be responsible for the accurate replacement or relocation of such reference points or property monuments by professionally qualified personnel.

4.04 *Progress Schedule*

A. Contractor shall adhere to the Progress Schedule established in accordance with Paragraph 2.05 as it may be adjusted from time to time as provided below.

1. Contractor shall submit to Engineer for acceptance (to the extent indicated in Paragraph 2.05) proposed adjustments in the Progress Schedule that will not result in changing the Contract Times.

2. Proposed adjustments in the Progress Schedule that will change the Contract Times must be submitted in accordance with the requirements of Article 11.

B. Contractor shall carry on the Work and adhere to the Progress Schedule during all disputes or disagreements with Owner. No Work will be delayed or postponed pending resolution of any disputes or disagreements, or during any appeal process, except as permitted by Paragraph 16.04, or as Owner and Contractor may otherwise agree in writing.

4.05 *Delays in Contractor's Progress*

A. If Owner, Engineer, or anyone for whom Owner is responsible, delays, disrupts, or interferes with the performance or progress of the Work, then Contractor shall be entitled to an equitable adjustment in Contract Price or Contract Times.

B. Contractor shall not be entitled to an adjustment in Contract Price or Contract Times for delay, disruption, or interference caused by or within the control of Contractor. Delay, disruption, and interference attributable to and within the control of a Subcontractor or Supplier shall be deemed to be within the control of Contractor.

C. If Contractor's performance or progress is delayed, disrupted, or interfered with by unanticipated causes not the fault of and beyond the control of Owner, Contractor, and those for which they are responsible, then Contractor shall be entitled to an equitable adjustment in Contract Times. Such an adjustment will be Contractor's sole and exclusive remedy for the delays, disruption, and interference described in this paragraph. Causes of delay, disruption, or interference that may give rise to an adjustment in Contract Times under this paragraph include but are not limited to the following:

1. Severe and unavoidable natural catastrophes such as fires, floods, epidemics, and earthquakes;

2. Abnormal weather conditions;

3. Acts or failures to act of third-party utility owners or other third-party entities (other than those third-party utility owners or other third-party entities performing other work at or adjacent to the Site as arranged by or under contract with Owner, as contemplated in Article 8); and

4. Acts of war or terrorism.

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D. Contractor's entitlement to an adjustment of Contract Times or Contract Price is limited as follows:

1. Contractor's entitlement to an adjustment of the Contract Times is conditioned on the delay, disruption, or interference adversely affecting an activity on the critical path to completion of the Work, as of the time of the delay, disruption, or interference.

2. Contractor shall not be entitled to an adjustment in Contract Price for any delay, disruption, or interference if such delay is concurrent with a delay, disruption, or interference caused by or within the control of Contractor. Such a concurrent delay by Contractor shall not preclude an adjustment of Contract Times to which Contractor is otherwise entitled.

3. Adjustments of Contract Times or Contract Price are subject to the provisions of Article 11.

E. Each Contractor request or Change Proposal seeking an increase in Contract Times or Contract Price must be supplemented by supporting data that sets forth in detail the following:

1. The circumstances that form the basis for the requested adjustment;

2. The date upon which each cause of delay, disruption, or interference began to affect the progress of the Work;

3. The date upon which each cause of delay, disruption, or interference ceased to affect the progress of the Work;

4. The number of days' increase in Contract Times claimed as a consequence of each such cause of delay, disruption, or interference; and

5. The impact on Contract Price, in accordance with the provisions of Paragraph 11.07.

Contractor shall also furnish such additional supporting documentation as Owner or Engineer may require including, where appropriate, a revised progress schedule indicating all the activities affected by the delay, disruption, or interference, and an explanation of the effect of the delay, disruption, or interference on the critical path to completion of the Work.

F. Delays, disruption, and interference to the performance or progress of the Work resulting from the existence of a differing subsurface or physical condition, an Underground Facility that was not shown or indicated by the Contract Documents, or not shown or indicated with reasonable accuracy, and those resulting from Hazardous Environmental Conditions, are governed by Article 5, together with the provisions of Paragraphs 4.05.D and 4.05.E.

G. Paragraph 8.03 addresses delays, disruption, and interference to the performance or progress of the Work resulting from the performance of certain other work at or adjacent to the Site.

ARTICLE 5—SITE; SUBSURFACE AND PHYSICAL CONDITIONS; HAZARDOUS ENVIRONMENTAL CONDITIONS

5.01 *Availability of Lands*

A. Owner shall furnish the Site. Owner shall notify Contractor in writing of any encumbrances or restrictions not of general application but specifically related to use of the Site with which Contractor must comply in performing the Work.

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B. Upon reasonable written request, Owner shall furnish Contractor with a current statement of record legal title and legal description of the lands upon which permanent improvements are to be made and Owner's interest therein as necessary for giving notice of or filing a mechanic's or construction lien against such lands in accordance with applicable Laws and Regulations.

C. Contractor shall provide for all additional lands and access thereto that may be required for temporary construction facilities or storage of materials and equipment.

5.02 *Use of Site and Other Areas*

A. *Limitation on Use of Site and Other Areas*

1. Contractor shall confine construction equipment, temporary construction facilities, the storage of materials and equipment, and the operations of workers to the Site, adjacent areas that Contractor has arranged to use through construction easements or otherwise, and other adjacent areas permitted by Laws and Regulations, and shall not unreasonably encumber the Site and such other adjacent areas with construction equipment or other materials or equipment. Contractor shall assume full responsibility for (a) damage to the Site; (b) damage to any such other adjacent areas used for Contractor's operations; (c) damage to any other adjacent land or areas, or to improvements, structures, utilities, or similar facilities located at such adjacent lands or areas; and (d) for injuries and losses sustained by the owners or occupants of any such land or areas; provided that such damage or injuries result from the performance of the Work or from other actions or conduct of the Contractor or those for which Contractor is responsible.

2. If a damage or injury claim is made by the owner or occupant of any such land or area because of the performance of the Work, or because of other actions or conduct of the Contractor or those for which Contractor is responsible, Contractor shall (a) take immediate corrective or remedial action as required by Paragraph 7.13, or otherwise; (b) promptly attempt to settle the claim as to all parties through negotiations with such owner or occupant, or otherwise resolve the claim by arbitration or other dispute resolution proceeding, or in a court of competent jurisdiction; and (c) to the fullest extent permitted by Laws and Regulations, indemnify and hold harmless Owner and Engineer, and the officers, directors, members, partners, employees, agents, consultants and subcontractors of each and any of them, from and against any such claim, and against all costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to any claim or action, legal or equitable, brought by any such owner or occupant against Owner, Engineer, or any other party indemnified hereunder to the extent caused directly or indirectly, in whole or in part by, or based upon, Contractor's performance of the Work, or because of other actions or conduct of the Contractor or those for which Contractor is responsible.

B. *Removal of Debris During Performance of the Work*: During the progress of the Work the Contractor shall keep the Site and other adjacent areas free from accumulations of waste materials, rubbish, and other debris. Removal and disposal of such waste materials, rubbish, and other debris will conform to applicable Laws and Regulations.

C. *Cleaning*: Prior to Substantial Completion of the Work Contractor shall clean the Site and the Work and make it ready for utilization by Owner. At the completion of the Work Contractor shall remove from the Site and adjacent areas all tools, appliances, construction equipment

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and machinery, and surplus materials and shall restore to original condition all property not designated for alteration by the Contract Documents.

D. *Loading of Structures*: Contractor shall not load nor permit any part of any structure to be loaded in any manner that will endanger the structure, nor shall Contractor subject any part of the Work or adjacent structures or land to stresses or pressures that will endanger them.

5.03 *Subsurface and Physical Conditions*

A. *Reports and Drawings*: The Supplementary Conditions identify:

1. Those reports of explorations and tests of subsurface conditions at or adjacent to the Site that contain Technical Data;

2. Those drawings of existing physical conditions at or adjacent to the Site, including those drawings depicting existing surface or subsurface structures at or adjacent to the Site (except Underground Facilities), that contain Technical Data; and

3. Technical Data contained in such reports and drawings.

B. *Underground Facilities*: Underground Facilities are shown or indicated on the Drawings, pursuant to Paragraph 5.05, and not in the drawings referred to in Paragraph 5.03.A. Information and data regarding the presence or location of Underground Facilities are not intended to be categorized, identified, or defined as Technical Data.

C. *Reliance by Contractor on Technical Data*: Contractor may rely upon the accuracy of the Technical Data expressly identified in the Supplementary Conditions with respect to such reports and drawings, but such reports and drawings are not Contract Documents. If no such express identification has been made, then Contractor may rely upon the accuracy of the Technical Data as defined in Paragraph 1.01.A.46.b.

D. *Limitations of Other Data and Documents*: Except for such reliance on Technical Data, Contractor may not rely upon or make any claim against Owner or Engineer, or any of their officers, directors, members, partners, employees, agents, consultants, or subcontractors, with respect to:

1. the completeness of such reports and drawings for Contractor's purposes, including, but not limited to, any aspects of the means, methods, techniques, sequences, and procedures of construction to be employed by Contractor, and safety precautions and programs incident thereto;

2. other data, interpretations, opinions, and information contained in such reports or shown or indicated in such drawings;

3. the contents of other Site-related documents made available to Contractor, such as record drawings from other projects at or adjacent to the Site, or Owner's archival documents concerning the Site; or

4. any Contractor interpretation of or conclusion drawn from any Technical Data or any such other data, interpretations, opinions, or information.

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5.04 *Differing Subsurface or Physical Conditions*

A. *Notice by Contractor*: If Contractor believes that any subsurface or physical condition that is uncovered or revealed at the Site:

1. is of such a nature as to establish that any Technical Data on which Contractor is entitled to rely as provided in Paragraph 5.03 is materially inaccurate;

2. is of such a nature as to require a change in the Drawings or Specifications;

3. differs materially from that shown or indicated in the Contract Documents; or

4. is of an unusual nature, and differs materially from conditions ordinarily encountered and generally recognized as inherent in work of the character provided for in the Contract Documents;

then Contractor shall, promptly after becoming aware thereof and before further disturbing the subsurface or physical conditions or performing any Work in connection therewith (except in an emergency as required by Paragraph 7.15), notify Owner and Engineer in writing about such condition. Contractor shall not further disturb such condition or perform any Work in connection therewith (except with respect to an emergency) until receipt of a written statement permitting Contractor to do so.

B. *Engineer's Review*: After receipt of written notice as required by the preceding paragraph, Engineer will promptly review the subsurface or physical condition in question; determine whether it is necessary for Owner to obtain additional exploration or tests with respect to the condition; conclude whether the condition falls within any one or more of the differing site condition categories in Paragraph 5.04.A; obtain any pertinent cost or schedule information from Contractor; prepare recommendations to Owner regarding the Contractor's resumption of Work in connection with the subsurface or physical condition in question and the need for any change in the Drawings or Specifications; and advise Owner in writing of Engineer's findings, conclusions, and recommendations.

C. *Owner's Statement to Contractor Regarding Site Condition*: After receipt of Engineer's written findings, conclusions, and recommendations, Owner shall issue a written statement to Contractor (with a copy to Engineer) regarding the subsurface or physical condition in question, addressing the resumption of Work in connection with such condition, indicating whether any change in the Drawings or Specifications will be made, and adopting or rejecting Engineer's written findings, conclusions, and recommendations, in whole or in part.

D. *Early Resumption of Work*: If at any time Engineer determines that Work in connection with the subsurface or physical condition in question may resume prior to completion of Engineer's review or Owner's issuance of its statement to Contractor, because the condition in question has been adequately documented, and analyzed on a preliminary basis, then the Engineer may at its discretion instruct Contractor to resume such Work.

E. *Possible Price and Times Adjustments*

1. Contractor shall be entitled to an equitable adjustment in Contract Price or Contract Times, to the extent that the existence of a differing subsurface or physical condition, or any related delay, disruption, or interference, causes an increase or decrease in

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Contractor's cost of, or time required for, performance of the Work; subject, however, to the following:

a. Such condition must fall within any one or more of the categories described in Paragraph 5.04.A;

b. With respect to Work that is paid for on a unit price basis, any adjustment in Contract Price will be subject to the provisions of Paragraph 13.03; and,

c. Contractor's entitlement to an adjustment of the Contract Times is subject to the provisions of Paragraphs 4.05.D and 4.05.E.

2. Contractor shall not be entitled to any adjustment in the Contract Price or Contract Times with respect to a subsurface or physical condition if:

a. Contractor knew of the existence of such condition at the time Contractor made a commitment to Owner with respect to Contract Price and Contract Times by the submission of a Bid or becoming bound under a negotiated contract, or otherwise;

b. The existence of such condition reasonably could have been discovered or revealed as a result of any examination, investigation, exploration, test, or study of the Site and contiguous areas expressly required by the Bidding Requirements or Contract Documents to be conducted by or for Contractor prior to Contractor's making such commitment; or

c. Contractor failed to give the written notice required by Paragraph 5.04.A.

3. If Owner and Contractor agree regarding Contractor's entitlement to and the amount or extent of any adjustment in the Contract Price or Contract Times, then any such adjustment will be set forth in a Change Order.

4. Contractor may submit a Change Proposal regarding its entitlement to or the amount or extent of any adjustment in the Contract Price or Contract Times, no later than 30 days after Owner's issuance of the Owner's written statement to Contractor regarding the subsurface or physical condition in question.

F. *Underground Facilities; Hazardous Environmental Conditions*: Paragraph 5.05 governs rights and responsibilities regarding the presence or location of Underground Facilities. Paragraph 5.06 governs rights and responsibilities regarding Hazardous Environmental Conditions. The provisions of Paragraphs 5.03 and 5.04 are not applicable to the presence or location of Underground Facilities, or to Hazardous Environmental Conditions.

5.05 *Underground Facilities*

A. *Contractor's Responsibilities*: Unless it is otherwise expressly provided in the Supplementary Conditions, the cost of all of the following are included in the Contract Price, and Contractor shall have full responsibility for:

1. reviewing and checking all information and data regarding existing Underground Facilities at the Site;

2. complying with applicable state and local utility damage prevention Laws and Regulations;

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3. verifying the actual location of those Underground Facilities shown or indicated in the Contract Documents as being within the area affected by the Work, by exposing such Underground Facilities during the course of construction;

4. coordination of the Work with the owners (including Owner) of such Underground Facilities, during construction; and

5. the safety and protection of all existing Underground Facilities at the Site, and repairing any damage thereto resulting from the Work.

B. *Notice by Contractor*: If Contractor believes that an Underground Facility that is uncovered or revealed at the Site was not shown or indicated on the Drawings, or was not shown or indicated on the Drawings with reasonable accuracy, then Contractor shall, promptly after becoming aware thereof and before further disturbing conditions affected thereby or performing any Work in connection therewith (except in an emergency as required by Paragraph 7.15), notify Owner and Engineer in writing regarding such Underground Facility.

C. *Engineer's Review*: Engineer will:

1. promptly review the Underground Facility and conclude whether such Underground Facility was not shown or indicated on the Drawings, or was not shown or indicated with reasonable accuracy;

2. identify and communicate with the owner of the Underground Facility; prepare recommendations to Owner (and if necessary issue any preliminary instructions to Contractor) regarding the Contractor's resumption of Work in connection with the Underground Facility in question;

3. obtain any pertinent cost or schedule information from Contractor; determine the extent, if any, to which a change is required in the Drawings or Specifications to reflect and document the consequences of the existence or location of the Underground Facility; and

4. advise Owner in writing of Engineer's findings, conclusions, and recommendations.

During such time, Contractor shall be responsible for the safety and protection of such Underground Facility.

D. *Owner's Statement to Contractor Regarding Underground Facility*: After receipt of Engineer's written findings, conclusions, and recommendations, Owner shall issue a written statement to Contractor (with a copy to Engineer) regarding the Underground Facility in question addressing the resumption of Work in connection with such Underground Facility, indicating whether any change in the Drawings or Specifications will be made, and adopting or rejecting Engineer's written findings, conclusions, and recommendations in whole or in part.

E. *Early Resumption of Work*: If at any time Engineer determines that Work in connection with the Underground Facility may resume prior to completion of Engineer's review or Owner's issuance of its statement to Contractor, because the Underground Facility in question and conditions affected by its presence have been adequately documented, and analyzed on a preliminary basis, then the Engineer may at its discretion instruct Contractor to resume such Work.

F. *Possible Price and Times Adjustments*

1. Contractor shall be entitled to an equitable adjustment in the Contract Price or Contract Times, to the extent that any existing Underground Facility at the Site that was not shown

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or indicated on the Drawings, or was not shown or indicated with reasonable accuracy, or any related delay, disruption, or interference, causes an increase or decrease in Contractor's cost of, or time required for, performance of the Work; subject, however, to the following:

a. With respect to Work that is paid for on a unit price basis, any adjustment in Contract Price will be subject to the provisions of Paragraph 13.03;

b. Contractor's entitlement to an adjustment of the Contract Times is subject to the provisions of Paragraphs 4.05.D and 4.05.E; and

c. Contractor gave the notice required in Paragraph 5.05.B.

2. If Owner and Contractor agree regarding Contractor's entitlement to and the amount or extent of any adjustment in the Contract Price or Contract Times, then any such adjustment will be set forth in a Change Order.

3. Contractor may submit a Change Proposal regarding its entitlement to or the amount or extent of any adjustment in the Contract Price or Contract Times, no later than 30 days after Owner's issuance of the Owner's written statement to Contractor regarding the Underground Facility in question.

4. The information and data shown or indicated on the Drawings with respect to existing Underground Facilities at the Site is based on information and data (a) furnished by the owners of such Underground Facilities, or by others, (b) obtained from available records, or (c) gathered in an investigation conducted in accordance with the current edition of ASCE 38, Standard Guideline for the Collection and Depiction of Existing Subsurface Utility Data, by the American Society of Civil Engineers. If such information or data is incorrect or incomplete, Contractor's remedies are limited to those set forth in this Paragraph 5.05.F.

5.06 *Hazardous Environmental Conditions at Site*

A. *Reports and Drawings*: The Supplementary Conditions identify:

1. those reports known to Owner relating to Hazardous Environmental Conditions that have been identified at or adjacent to the Site;

2. drawings known to Owner relating to Hazardous Environmental Conditions that have been identified at or adjacent to the Site; and

3. Technical Data contained in such reports and drawings.

B. *Reliance by Contractor on Technical Data Authorized*: Contractor may rely upon the accuracy of the Technical Data expressly identified in the Supplementary Conditions with respect to such reports and drawings, but such reports and drawings are not Contract Documents. If no such express identification has been made, then Contractor may rely on the accuracy of the Technical Data as defined in Paragraph 1.01.A.46.b. Except for such reliance on Technical Data, Contractor may not rely upon or make any claim against Owner or Engineer, or any of their officers, directors, members, partners, employees, agents, consultants, or subcontractors, with respect to:

1. the completeness of such reports and drawings for Contractor's purposes, including, but not limited to, any aspects of the means, methods, techniques, sequences and procedures

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of construction to be employed by Contractor, and safety precautions and programs incident thereto;

2. other data, interpretations, opinions, and information contained in such reports or shown or indicated in such drawings; or

3. any Contractor interpretation of or conclusion drawn from any Technical Data or any such other data, interpretations, opinions or information.

C. Contractor shall not be responsible for removing or remediating any Hazardous Environmental Condition encountered, uncovered, or revealed at the Site unless such removal or remediation is expressly identified in the Contract Documents to be within the scope of the Work.

D. Contractor shall be responsible for controlling, containing, and duly removing all Constituents of Concern brought to the Site by Contractor, Subcontractors, Suppliers, or anyone else for whom Contractor is responsible, and for any associated costs; and for the costs of removing and remediating any Hazardous Environmental Condition created by the presence of any such Constituents of Concern.

E. If Contractor encounters, uncovers, or reveals a Hazardous Environmental Condition whose removal or remediation is not expressly identified in the Contract Documents as being within the scope of the Work, or if Contractor or anyone for whom Contractor is responsible creates a Hazardous Environmental Condition, then Contractor shall immediately: (1) secure or otherwise isolate such condition; (2) stop all Work in connection with such condition and in any area affected thereby (except in an emergency as required by Paragraph 7.15); and (3) notify Owner and Engineer (and promptly thereafter confirm such notice in writing). Owner shall promptly consult with Engineer concerning the necessity for Owner to retain a qualified expert to evaluate such condition or take corrective action, if any. Promptly after consulting with Engineer, Owner shall take such actions as are necessary to permit Owner to timely obtain required permits and provide Contractor the written notice required by Paragraph 5.06.F. If Contractor or anyone for whom Contractor is responsible created the Hazardous Environmental Condition in question, then Owner may remove and remediate the Hazardous Environmental Condition, and impose a set-off against payments to account for the associated costs.

F. Contractor shall not resume Work in connection with such Hazardous Environmental Condition or in any affected area until after Owner has obtained any required permits related thereto, and delivered written notice to Contractor either (1) specifying that such condition and any affected area is or has been rendered safe for the resumption of Work, or (2) specifying any special conditions under which such Work may be resumed safely.

G. If Owner and Contractor cannot agree as to entitlement to or on the amount or extent, if any, of any adjustment in Contract Price or Contract Times, as a result of such Work stoppage, such special conditions under which Work is agreed to be resumed by Contractor, or any costs or expenses incurred in response to the Hazardous Environmental Condition, then within 30 days of Owner's written notice regarding the resumption of Work, Contractor may submit a Change Proposal, or Owner may impose a set-off. Entitlement to any such adjustment is subject to the provisions of Paragraphs 4.05.D, 4.05.E, 11.07, and 11.08.

H. If, after receipt of such written notice, Contractor does not agree to resume such Work based on a reasonable belief it is unsafe, or does not agree to resume such Work under such special

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conditions, then Owner may order the portion of the Work that is in the area affected by such condition to be deleted from the Work, following the contractual change procedures in Article 11. Owner may have such deleted portion of the Work performed by Owner's own forces or others in accordance with Article 8.

I. To the fullest extent permitted by Laws and Regulations, Owner shall indemnify and hold harmless Contractor, Subcontractors, and Engineer, and the officers, directors, members, partners, employees, agents, consultants, and subcontractors of each and any of them, from and against all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals, and all court, arbitration, or other dispute resolution costs) arising out of or relating to a Hazardous Environmental Condition, provided that such Hazardous Environmental Condition (1) was not shown or indicated in the Drawings, Specifications, or other Contract Documents, identified as Technical Data entitled to limited reliance pursuant to Paragraph 5.06.B, or identified in the Contract Documents to be included within the scope of the Work, and (2) was not created by Contractor or by anyone for whom Contractor is responsible. Nothing in this Paragraph 5.06.I obligates Owner to indemnify any individual or entity from and against the consequences of that individual's or entity's own negligence.

J. To the fullest extent permitted by Laws and Regulations, Contractor shall indemnify and hold harmless Owner and Engineer, and the officers, directors, members, partners, employees, agents, consultants, and subcontractors of each and any of them, from and against all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to the failure to control, contain, or remove a Constituent of Concern brought to the Site by Contractor or by anyone for whom Contractor is responsible, or to a Hazardous Environmental Condition created by Contractor or by anyone for whom Contractor is responsible. Nothing in this Paragraph 5.06.J obligates Contractor to indemnify any individual or entity from and against the consequences of that individual's or entity's own negligence.

K. The provisions of Paragraphs 5.03, 5.04, and 5.05 do not apply to the presence of Constituents of Concern or to a Hazardous Environmental Condition uncovered or revealed at the Site.

ARTICLE 6—BONDS AND INSURANCE

6.01 *Performance, Payment, and Other Bonds*

A. Contractor shall furnish a performance bond and a payment bond, each in an amount at least equal to the Contract Price, as security for the faithful performance and payment of Contractor's obligations under the Contract. These bonds must remain in effect until one year after the date when final payment becomes due or until completion of the correction period specified in Paragraph 15.08, whichever is later, except as provided otherwise by Laws or Regulations, the terms of a prescribed bond form, the Supplementary Conditions, or other provisions of the Contract.

B. Contractor shall also furnish such other bonds (if any) as are required by the Supplementary Conditions or other provisions of the Contract.

C. All bonds must be in the form included in the Bidding Documents or otherwise specified by Owner prior to execution of the Contract, except as provided otherwise by Laws or

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Regulations, and must be issued and signed by a surety named in "Companies Holding Certificates of Authority as Acceptable Sureties on Federal Bonds and as Acceptable Reinsuring Companies" as published in Department Circular 570 (as amended and supplemented) by the Bureau of the Fiscal Service, U.S. Department of the Treasury. A bond signed by an agent or attorney-in-fact must be accompanied by a certified copy of that individual's authority to bind the surety. The evidence of authority must show that it is effective on the date the agent or attorney-in-fact signed the accompanying bond.

D. Contractor shall obtain the required bonds from surety companies that are duly licensed or authorized, in the state or jurisdiction in which the Project is located, to issue bonds in the required amounts.

E. If the surety on a bond furnished by Contractor is declared bankrupt or becomes insolvent, or the surety ceases to meet the requirements above, then Contractor shall promptly notify Owner and Engineer in writing and shall, within 20 days after the event giving rise to such notification, provide another bond and surety, both of which must comply with the bond and surety requirements above.

F. If Contractor has failed to obtain a required bond, Owner may exclude the Contractor from the Site and exercise Owner's termination rights under Article 16.

G. Upon request to Owner from any Subcontractor, Supplier, or other person or entity claiming to have furnished labor, services, materials, or equipment used in the performance of the Work, Owner shall provide a copy of the payment bond to such person or entity.

H. Upon request to Contractor from any Subcontractor, Supplier, or other person or entity claiming to have furnished labor, services, materials, or equipment used in the performance of the Work, Contractor shall provide a copy of the payment bond to such person or entity.

6.02 *Insurance—General Provisions*

A. Owner and Contractor shall obtain and maintain insurance as required in this article and in the Supplementary Conditions.

B. All insurance required by the Contract to be purchased and maintained by Owner or Contractor shall be obtained from insurance companies that are duly licensed or authorized in the state or jurisdiction in which the Project is located to issue insurance policies for the required limits and coverages. Unless a different standard is indicated in the Supplementary Conditions, all companies that provide insurance policies required under this Contract shall have an A.M. Best rating of A-VII or better.

C. Alternative forms of insurance coverage, including but not limited to self-insurance and "Occupational Accident and Excess Employer's Indemnity Policies," are not sufficient to meet the insurance requirements of this Contract, unless expressly allowed in the Supplementary Conditions.

D. Contractor shall deliver to Owner, with copies to each additional insured identified in the Contract, certificates of insurance and endorsements establishing that Contractor has obtained and is maintaining the policies and coverages required by the Contract. Upon request by Owner or any other insured, Contractor shall also furnish other evidence of such required insurance, including but not limited to copies of policies, documentation of applicable self-insured retentions (if allowed) and deductibles, full disclosure of all relevant exclusions, and evidence of insurance required to be purchased and maintained by

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Subcontractors or Suppliers. In any documentation furnished under this provision, Contractor, Subcontractors, and Suppliers may block out (redact) (1) any confidential premium or pricing information and (2) any wording specific to a project or jurisdiction other than those applicable to this Contract.

E. Owner shall deliver to Contractor, with copies to each additional insured identified in the Contract, certificates of insurance and endorsements establishing that Owner has obtained and is maintaining the policies and coverages required of Owner by the Contract (if any). Upon request by Contractor or any other insured, Owner shall also provide other evidence of such required insurance (if any), including but not limited to copies of policies, documentation of applicable self-insured retentions (if allowed) and deductibles, and full disclosure of all relevant exclusions. In any documentation furnished under this provision, Owner may block out (redact) (1) any confidential premium or pricing information and (2) any wording specific to a project or jurisdiction other than those relevant to this Contract.

F. Failure of Owner or Contractor to demand such certificates or other evidence of the other party's full compliance with these insurance requirements, or failure of Owner or Contractor to identify a deficiency in compliance from the evidence provided, will not be construed as a waiver of the other party's obligation to obtain and maintain such insurance.

G. In addition to the liability insurance required to be provided by Contractor, the Owner, at Owner's option, may purchase and maintain Owner's own liability insurance. Owner's liability policies, if any, operate separately and independently from policies required to be provided by Contractor, and Contractor cannot rely upon Owner's liability policies for any of Contractor's obligations to the Owner, Engineer, or third parties.

H. Contractor shall require:

1. Subcontractors to purchase and maintain worker's compensation, commercial general liability, and other insurance that is appropriate for their participation in the Project, and to name as additional insureds Owner and Engineer (and any other individuals or entities identified in the Supplementary Conditions as additional insureds on Contractor's liability policies) on each Subcontractor's commercial general liability insurance policy; and

2. Suppliers to purchase and maintain insurance that is appropriate for their participation in the Project.

I. If either party does not purchase or maintain the insurance required of such party by the Contract, such party shall notify the other party in writing of such failure to purchase prior to the start of the Work, or of such failure to maintain prior to any change in the required coverage.

J. If Contractor has failed to obtain and maintain required insurance, Contractor's entitlement to enter or remain at the Site will end immediately, and Owner may impose an appropriate set-off against payment for any associated costs (including but not limited to the cost of purchasing necessary insurance coverage), and exercise Owner's termination rights under Article 16.

K. Without prejudice to any other right or remedy, if a party has failed to obtain required insurance, the other party may elect (but is in no way obligated) to obtain equivalent insurance to protect such other party's interests at the expense of the party who was required to provide such coverage, and the Contract Price will be adjusted accordingly.

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L. Owner does not represent that insurance coverage and limits established in this Contract necessarily will be adequate to protect Contractor or Contractor's interests. Contractor is responsible for determining whether such coverage and limits are adequate to protect its interests, and for obtaining and maintaining any additional insurance that Contractor deems necessary.

M. The insurance and insurance limits required herein will not be deemed as a limitation on Contractor's liability, or that of its Subcontractors or Suppliers, under the indemnities granted to Owner and other individuals and entities in the Contract or otherwise.

N. All the policies of insurance required to be purchased and maintained under this Contract will contain a provision or endorsement that the coverage afforded will not be canceled, or renewal refused, until at least 10 days prior written notice has been given to the purchasing policyholder. Within three days of receipt of any such written notice, the purchasing policyholder shall provide a copy of the notice to each other insured and Engineer.

6.03 *Contractor's Insurance*

A. *Required Insurance*: Contractor shall purchase and maintain Worker's Compensation, Commercial General Liability, and other insurance pursuant to the specific requirements of the Supplementary Conditions.

B. *General Provisions*: The policies of insurance required by this Paragraph 6.03 as supplemented must:

1. include at least the specific coverages required;

2. be written for not less than the limits provided, or those required by Laws or Regulations, whichever is greater;

3. remain in effect at least until the Work is complete (as set forth in Paragraph 15.06.D), and longer if expressly required elsewhere in this Contract, and at all times thereafter when Contractor may be correcting, removing, or replacing defective Work as a warranty or correction obligation, or otherwise, or returning to the Site to conduct other tasks arising from the Contract;

4. apply with respect to the performance of the Work, whether such performance is by Contractor, any Subcontractor or Supplier, or by anyone directly or indirectly employed by any of them to perform any of the Work, or by anyone for whose acts any of them may be liable; and

5. include all necessary endorsements to support the stated requirements.

C. *Additional Insureds*: The Contractor's commercial general liability, automobile liability, employer's liability, umbrella or excess, pollution liability, and unmanned aerial vehicle liability policies, if required by this Contract, must:

1. include and list as additional insureds Owner and Engineer, and any individuals or entities identified as additional insureds in the Supplementary Conditions;

2. include coverage for the respective officers, directors, members, partners, employees, and consultants of all such additional insureds;

3. afford primary coverage to these additional insureds for all claims covered thereby (including as applicable those arising from both ongoing and completed operations);

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4. not seek contribution from insurance maintained by the additional insured; and

5. as to commercial general liability insurance, apply to additional insureds with respect to liability caused in whole or in part by Contractor's acts or omissions, or the acts and omissions of those working on Contractor's behalf, in the performance of Contractor's operations.

6.04 *Builder's Risk and Other Property Insurance*

A. *Builder's Risk*: Unless otherwise provided in the Supplementary Conditions, Contractor shall purchase and maintain builder's risk insurance upon the Work on a completed value basis, in the amount of the Work's full insurable replacement cost (subject to such deductible amounts as may be provided in the Supplementary Conditions or required by Laws and Regulations). The specific requirements applicable to the builder's risk insurance are set forth in the Supplementary Conditions.

B. *Property Insurance for Facilities of Owner Where Work Will Occur*: Owner is responsible for obtaining and maintaining property insurance covering each existing structure, building, or facility in which any part of the Work will occur, or to which any part of the Work will attach or be adjoined. Such property insurance will be written on a special perils (all-risk) form, on a replacement cost basis, providing coverage consistent with that required for the builder's risk insurance, and will be maintained until the Work is complete, as set forth in Paragraph 15.06.D.

C. *Property Insurance for Substantially Complete Facilities*: Promptly after Substantial Completion, and before actual occupancy or use of the substantially completed Work, Owner will obtain property insurance for such substantially completed Work, and maintain such property insurance at least until the Work is complete, as set forth in Paragraph 15.06.D. Such property insurance will be written on a special perils (all-risk) form, on a replacement cost basis, and provide coverage consistent with that required for the builder's risk insurance. The builder's risk insurance may terminate upon written confirmation of Owner's procurement of such property insurance.

D. *Partial Occupancy or Use by Owner*: If Owner will occupy or use a portion or portions of the Work prior to Substantial Completion of all the Work, as provided in Paragraph 15.04, then Owner (directly, if it is the purchaser of the builder's risk policy, or through Contractor) will provide advance notice of such occupancy or use to the builder's risk insurer, and obtain an endorsement consenting to the continuation of coverage prior to commencing such partial occupancy or use.

E. *Insurance of Other Property; Additional Insurance*: If the express insurance provisions of the Contract do not require or address the insurance of a property item or interest, then the entity or individual owning such property item will be responsible for insuring it. If Contractor elects to obtain other special insurance to be included in or supplement the builder's risk or property insurance policies provided under this Paragraph 6.04, it may do so at Contractor's expense.

6.05 *Property Losses; Subrogation*

A. The builder's risk insurance policy purchased and maintained in accordance with Paragraph 6.04 (or an installation floater policy if authorized by the Supplementary Conditions), will contain provisions to the effect that in the event of payment of any loss or damage the insurer will have no rights of recovery against any insureds thereunder, or against

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Engineer or its consultants, or their officers, directors, members, partners, employees, agents, consultants, or subcontractors.

1. Owner and Contractor waive all rights against each other and the respective officers, directors, members, partners, employees, agents, consultants, and subcontractors of each and any of them, for all losses and damages caused by, arising out of, or resulting from any of the perils, risks, or causes of loss covered by such policies and any other property insurance applicable to the Work; and, in addition, waive all such rights against Engineer, its consultants, all individuals or entities identified in the Supplementary Conditions as builder's risk or installation floater insureds, and the officers, directors, members, partners, employees, agents, consultants, and subcontractors of each and any of them, under such policies for losses and damages so caused.

2. None of the above waivers extends to the rights that any party making such waiver may have to the proceeds of insurance held by Owner or Contractor as trustee or fiduciary, or otherwise payable under any policy so issued.

B. Any property insurance policy maintained by Owner covering any loss, damage, or consequential loss to Owner's existing structures, buildings, or facilities in which any part of the Work will occur, or to which any part of the Work will attach or adjoin; to adjacent structures, buildings, or facilities of Owner; or to part or all of the completed or substantially completed Work, during partial occupancy or use pursuant to Paragraph 15.04, after Substantial Completion pursuant to Paragraph 15.03, or after final payment pursuant to Paragraph 15.06, will contain provisions to the effect that in the event of payment of any loss or damage the insurer will have no rights of recovery against any insureds thereunder, or against Contractor, Subcontractors, or Engineer, or the officers, directors, members, partners, employees, agents, consultants, or subcontractors of each and any of them, and that the insured is allowed to waive the insurer's rights of subrogation in a written contract executed prior to the loss, damage, or consequential loss.

1. Owner waives all rights against Contractor, Subcontractors, and Engineer, and the officers, directors, members, partners, employees, agents, consultants and subcontractors of each and any of them, for all losses and damages caused by, arising out of, or resulting from fire or any of the perils, risks, or causes of loss covered by such policies.

C. The waivers in this Paragraph 6.05 include the waiver of rights due to business interruption, loss of use, or other consequential loss extending beyond direct physical loss or damage to Owner's property or the Work caused by, arising out of, or resulting from fire or other insured peril, risk, or cause of loss.

D. Contractor shall be responsible for assuring that each Subcontract contains provisions whereby the Subcontractor waives all rights against Owner, Contractor, all individuals or entities identified in the Supplementary Conditions as insureds, the Engineer and its consultants, and the officers, directors, members, partners, employees, agents, consultants, and subcontractors of each and any of them, for all losses and damages caused by, arising out of, relating to, or resulting from fire or other peril, risk, or cause of loss covered by builder's risk insurance, installation floater, and any other property insurance applicable to the Work.

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6.06 *Receipt and Application of Property Insurance Proceeds*

A. Any insured loss under the builder's risk and other policies of property insurance required by Paragraph 6.04 will be adjusted and settled with the named insured that purchased the policy. Such named insured shall act as fiduciary for the other insureds, and give notice to such other insureds that adjustment and settlement of a claim is in progress. Any other insured may state its position regarding a claim for insured loss in writing within 15 days after notice of such claim.

B. Proceeds for such insured losses may be made payable by the insurer either jointly to multiple insureds, or to the named insured that purchased the policy in its own right and as fiduciary for other insureds, subject to the requirements of any applicable mortgage clause. A named insured receiving insurance proceeds under the builder's risk and other policies of insurance required by Paragraph 6.04 shall maintain such proceeds in a segregated account, and distribute such proceeds in accordance with such agreement as the parties in interest may reach, or as otherwise required under the dispute resolution provisions of this Contract or applicable Laws and Regulations.

C. If no other special agreement is reached, Contractor shall repair or replace the damaged Work, using allocated insurance proceeds.

ARTICLE 7—CONTRACTOR'S RESPONSIBILITIES

7.01 *Contractor's Means and Methods of Construction*

A. Contractor shall be solely responsible for the means, methods, techniques, sequences, and procedures of construction.

B. If the Contract Documents note, or Contractor determines, that professional engineering or other design services are needed to carry out Contractor's responsibilities for construction means, methods, techniques, sequences, and procedures, or for Site safety, then Contractor shall cause such services to be provided by a properly licensed design professional, at Contractor's expense. Such services are not Owner-delegated professional design services under this Contract, and neither Owner nor Engineer has any responsibility with respect to (1) Contractor's determination of the need for such services, (2) the qualifications or licensing of the design professionals retained or employed by Contractor, (3) the performance of such services, or (4) any errors, omissions, or defects in such services.

7.02 *Supervision and Superintendence*

A. Contractor shall supervise, inspect, and direct the Work competently and efficiently, devoting such attention thereto and applying such skills and expertise as may be necessary to perform the Work in accordance with the Contract Documents.

B. At all times during the progress of the Work, Contractor shall assign a competent resident superintendent who will not be replaced without written notice to Owner and Engineer except under extraordinary circumstances.

7.03 *Labor; Working Hours*

A. Contractor shall provide competent, suitably qualified personnel to survey and lay out the Work and perform construction as required by the Contract Documents. Contractor shall maintain good discipline and order at the Site.

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B. Contractor shall be fully responsible to Owner and Engineer for all acts and omissions of Contractor's employees; of Suppliers and Subcontractors, and their employees; and of any other individuals or entities performing or furnishing any of the Work, just as Contractor is responsible for Contractor's own acts and omissions.

C. Except as otherwise required for the safety or protection of persons or the Work or property at the Site or adjacent thereto, and except as otherwise stated in the Contract Documents, all Work at the Site will be performed during regular working hours, Monday through Friday. Contractor will not perform Work on a Saturday, Sunday, or any legal holiday. Contractor may perform Work outside regular working hours or on Saturdays, Sundays, or legal holidays only with Owner's written consent, which will not be unreasonably withheld.

7.04 *Services, Materials, and Equipment*

A. Unless otherwise specified in the Contract Documents, Contractor shall provide and assume full responsibility for all services, materials, equipment, labor, transportation, construction equipment and machinery, tools, appliances, fuel, power, light, heat, telephone, water, sanitary facilities, temporary facilities, and all other facilities and incidentals necessary for the performance, testing, start up, and completion of the Work, whether or not such items are specifically called for in the Contract Documents.

B. All materials and equipment incorporated into the Work must be new and of good quality, except as otherwise provided in the Contract Documents. All special warranties and guarantees required by the Specifications will expressly run to the benefit of Owner. If required by Engineer, Contractor shall furnish satisfactory evidence (including reports of required tests) as to the source, kind, and quality of materials and equipment.

C. All materials and equipment must be stored, applied, installed, connected, erected, protected, used, cleaned, and conditioned in accordance with instructions of the applicable Supplier, except as otherwise may be provided in the Contract Documents.

7.05 *"Or Equals"*

A. *Contractor's Request; Governing Criteria*: Whenever an item of equipment or material is specified or described in the Contract Documents by using the names of one or more proprietary items or specific Suppliers, the Contract Price has been based upon Contractor furnishing such item as specified. The specification or description of such an item is intended to establish the type, function, appearance, and quality required. Unless the specification or description contains or is followed by words reading that no like, equivalent, or "or equal" item is permitted, Contractor may request that Engineer authorize the use of other items of equipment or material, or items from other proposed Suppliers, under the circumstances described below.

1. If Engineer in its sole discretion determines that an item of equipment or material proposed by Contractor is functionally equal to that named and sufficiently similar so that no change in related Work will be required, Engineer will deem it an "or equal" item. For the purposes of this paragraph, a proposed item of equipment or material will be considered functionally equal to an item so named if:

a. in the exercise of reasonable judgment Engineer determines that the proposed item:

1) is at least equal in materials of construction, quality, durability, appearance, strength, and design characteristics;

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2) will reliably perform at least equally well the function and achieve the results imposed by the design concept of the completed Project as a functioning whole;

3) has a proven record of performance and availability of responsive service; and

4) is not objectionable to Owner.

b. Contractor certifies that, if the proposed item is approved and incorporated into the Work:

1) there will be no increase in cost to the Owner or increase in Contract Times; and

2) the item will conform substantially to the detailed requirements of the item named in the Contract Documents.

B. *Contractor's Expense*: Contractor shall provide all data in support of any proposed "or equal" item at Contractor's expense.

C. *Engineer's Evaluation and Determination*: Engineer will be allowed a reasonable time to evaluate each "or-equal" request. Engineer may require Contractor to furnish additional data about the proposed "or-equal" item. Engineer will be the sole judge of acceptability. No "or-equal" item will be ordered, furnished, installed, or utilized until Engineer's review is complete and Engineer determines that the proposed item is an "or-equal," which will be evidenced by an approved Shop Drawing or other written communication. Engineer will advise Contractor in writing of any negative determination.

D. *Effect of Engineer's Determination*: Neither approval nor denial of an "or-equal" request will result in any change in Contract Price. The Engineer's denial of an "or-equal" request will be final and binding, and may not be reversed through an appeal under any provision of the Contract.

E. *Treatment as a Substitution Request*: If Engineer determines that an item of equipment or material proposed by Contractor does not qualify as an "or-equal" item, Contractor may request that Engineer consider the item a proposed substitute pursuant to Paragraph 7.06.

7.06 *Substitutes*

A. *Contractor's Request; Governing Criteria*: Unless the specification or description of an item of equipment or material required to be furnished under the Contract Documents contains or is followed by words reading that no substitution is permitted, Contractor may request that Engineer authorize the use of other items of equipment or material under the circumstances described below. To the extent possible such requests must be made before commencement of related construction at the Site.

1. Contractor shall submit sufficient information as provided below to allow Engineer to determine if the item of material or equipment proposed is functionally equivalent to that named and an acceptable substitute therefor. Engineer will not accept requests for review of proposed substitute items of equipment or material from anyone other than Contractor.

2. The requirements for review by Engineer will be as set forth in Paragraph 7.06.B, as supplemented by the Specifications, and as Engineer may decide is appropriate under the circumstances.

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3. Contractor shall make written application to Engineer for review of a proposed substitute item of equipment or material that Contractor seeks to furnish or use. The application:

    a. will certify that the proposed substitute item will:

        1) perform adequately the functions and achieve the results called for by the general design;

        2) be similar in substance to the item specified; and

        3) be suited to the same use as the item specified.

    b. will state:

        1) the extent, if any, to which the use of the proposed substitute item will necessitate a change in Contract Times;

        2) whether use of the proposed substitute item in the Work will require a change in any of the Contract Documents (or in the provisions of any other direct contract with Owner for other work on the Project) to adapt the design to the proposed substitute item; and

        3) whether incorporation or use of the proposed substitute item in connection with the Work is subject to payment of any license fee or royalty.

    c. will identify:

        1) all variations of the proposed substitute item from the item specified; and

        2) available engineering, sales, maintenance, repair, and replacement services.

    d. will contain an itemized estimate of all costs or credits that will result directly or indirectly from use of such substitute item, including but not limited to changes in Contract Price, shared savings, costs of redesign, and claims of other contractors affected by any resulting change.

B. *Engineer's Evaluation and Determination*: Engineer will be allowed a reasonable time to evaluate each substitute request, and to obtain comments and direction from Owner. Engineer may require Contractor to furnish additional data about the proposed substitute item. Engineer will be the sole judge of acceptability. No substitute will be ordered, furnished, installed, or utilized until Engineer's review is complete and Engineer determines that the proposed item is an acceptable substitute. Engineer's determination will be evidenced by a Field Order or a proposed Change Order accounting for the substitution itself and all related impacts, including changes in Contract Price or Contract Times. Engineer will advise Contractor in writing of any negative determination.

C. *Special Guarantee*: Owner may require Contractor to furnish at Contractor's expense a special performance guarantee or other surety with respect to any substitute.

D. *Reimbursement of Engineer's Cost*: Engineer will record Engineer's costs in evaluating a substitute proposed or submitted by Contractor. Whether or not Engineer approves a substitute so proposed or submitted by Contractor, Contractor shall reimburse Owner for the reasonable charges of Engineer for evaluating each such proposed substitute. Contractor shall also reimburse Owner for the reasonable charges of Engineer for making changes in the Contract Documents (or in the provisions of any other direct contract with Owner) resulting from the acceptance of each proposed substitute.

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E. *Contractor's Expense*: Contractor shall provide all data in support of any proposed substitute at Contractor's expense.

F. *Effect of Engineer's Determination*: If Engineer approves the substitution request, Contractor shall execute the proposed Change Order and proceed with the substitution. The Engineer's denial of a substitution request will be final and binding, and may not be reversed through an appeal under any provision of the Contract. Contractor may challenge the scope of reimbursement costs imposed under Paragraph 7.06.D, by timely submittal of a Change Proposal.

7.07 *Concerning Subcontractors and Suppliers*

A. Contractor may retain Subcontractors and Suppliers for the performance of parts of the Work. Such Subcontractors and Suppliers must be acceptable to Owner. The Contractor's retention of a Subcontractor or Supplier for the performance of parts of the Work will not relieve Contractor's obligation to Owner to perform and complete the Work in accordance with the Contract Documents.

B. Contractor shall retain specific Subcontractors and Suppliers for the performance of designated parts of the Work if required by the Contract to do so.

C. Subsequent to the submittal of Contractor's Bid or final negotiation of the terms of the Contract, Owner may not require Contractor to retain any Subcontractor or Supplier to furnish or perform any of the Work against which Contractor has reasonable objection.

D. Prior to entry into any binding subcontract or purchase order, Contractor shall submit to Owner the identity of the proposed Subcontractor or Supplier (unless Owner has already deemed such proposed Subcontractor or Supplier acceptable during the bidding process or otherwise). Such proposed Subcontractor or Supplier shall be deemed acceptable to Owner unless Owner raises a substantive, reasonable objection within 5 days.

E. Owner may require the replacement of any Subcontractor or Supplier. Owner also may require Contractor to retain specific replacements; provided, however, that Owner may not require a replacement to which Contractor has a reasonable objection. If Contractor has submitted the identity of certain Subcontractors or Suppliers for acceptance by Owner, and Owner has accepted it (either in writing or by failing to make written objection thereto), then Owner may subsequently revoke the acceptance of any such Subcontractor or Supplier so identified solely on the basis of substantive, reasonable objection after due investigation. Contractor shall submit an acceptable replacement for the rejected Subcontractor or Supplier.

F. If Owner requires the replacement of any Subcontractor or Supplier retained by Contractor to perform any part of the Work, then Contractor shall be entitled to an adjustment in Contract Price or Contract Times, with respect to the replacement; and Contractor shall initiate a Change Proposal for such adjustment within 30 days of Owner's requirement of replacement.

G. No acceptance by Owner of any such Subcontractor or Supplier, whether initially or as a replacement, will constitute a waiver of the right of Owner to the completion of the Work in accordance with the Contract Documents.

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H. On a monthly basis, Contractor shall submit to Engineer a complete list of all Subcontractors and Suppliers having a direct contract with Contractor, and of all other Subcontractors and Suppliers known to Contractor at the time of submittal.

I. Contractor shall be solely responsible for scheduling and coordinating the work of Subcontractors and Suppliers.

J. The divisions and sections of the Specifications and the identifications of any Drawings do not control Contractor in dividing the Work among Subcontractors or Suppliers, or in delineating the Work to be performed by any specific trade.

K. All Work performed for Contractor by a Subcontractor or Supplier must be pursuant to an appropriate contractual agreement that specifically binds the Subcontractor or Supplier to the applicable terms and conditions of the Contract for the benefit of Owner and Engineer.

L. Owner may furnish to any Subcontractor or Supplier, to the extent practicable, information about amounts paid to Contractor for Work performed for Contractor by the Subcontractor or Supplier.

M. Contractor shall restrict all Subcontractors and Suppliers from communicating with Engineer or Owner, except through Contractor or in case of an emergency, or as otherwise expressly allowed in this Contract.

7.08 *Patent Fees and Royalties*

A. Contractor shall pay all license fees and royalties and assume all costs incident to the use in the performance of the Work or the incorporation in the Work of any invention, design, process, product, or device which is the subject of patent rights or copyrights held by others. If an invention, design, process, product, or device is specified in the Contract Documents for use in the performance of the Work and if, to the actual knowledge of Owner or Engineer, its use is subject to patent rights or copyrights calling for the payment of any license fee or royalty to others, the existence of such rights will be disclosed in the Contract Documents.

B. To the fullest extent permitted by Laws and Regulations, Owner shall indemnify and hold harmless Contractor, and its officers, directors, members, partners, employees, agents, consultants, and subcontractors, from and against all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals, and all court or arbitration or other dispute resolution costs) arising out of or relating to any infringement of patent rights or copyrights incident to the use in the performance of the Work or resulting from the incorporation in the Work of any invention, design, process, product, or device specified in the Contract Documents, but not identified as being subject to payment of any license fee or royalty to others required by patent rights or copyrights.

C. To the fullest extent permitted by Laws and Regulations, Contractor shall indemnify and hold harmless Owner and Engineer, and the officers, directors, members, partners, employees, agents, consultants and subcontractors of each and any of them, from and against all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to any infringement of patent rights or copyrights incident to the use in the performance of the Work or resulting from the incorporation in the Work of any invention, design, process, product, or device not specified in the Contract Documents.

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7.09 *Permits*

A. Unless otherwise provided in the Contract Documents, Contractor shall obtain and pay for all construction permits, licenses, and certificates of occupancy. Owner shall assist Contractor, when necessary, in obtaining such permits and licenses. Contractor shall pay all governmental charges and inspection fees necessary for the prosecution of the Work which are applicable at the time of the submission of Contractor's Bid (or when Contractor became bound under a negotiated contract). Owner shall pay all charges of utility owners for connections for providing permanent service to the Work.

7.10 *Taxes*

A. Contractor shall pay all sales, consumer, use, and other similar taxes required to be paid by Contractor in accordance with the Laws and Regulations of the place of the Project which are applicable during the performance of the Work.

7.11 *Laws and Regulations*

A. Contractor shall give all notices required by and shall comply with all Laws and Regulations applicable to the performance of the Work. Neither Owner nor Engineer shall be responsible for monitoring Contractor's compliance with any Laws or Regulations.

B. If Contractor performs any Work or takes any other action knowing or having reason to know that it is contrary to Laws or Regulations, Contractor shall bear all resulting costs and losses, and shall indemnify and hold harmless Owner and Engineer, and the officers, directors, members, partners, employees, agents, consultants, and subcontractors of each and any of them, from and against all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to such Work or other action. It is not Contractor's responsibility to make certain that the Work described in the Contract Documents is in accordance with Laws and Regulations, but this does not relieve Contractor of its obligations under Paragraph 3.03.

C. Owner or Contractor may give written notice to the other party of any changes after the submission of Contractor's Bid (or after the date when Contractor became bound under a negotiated contract) in Laws or Regulations having an effect on the cost or time of performance of the Work, including but not limited to changes in Laws or Regulations having an effect on procuring permits and on sales, use, value-added, consumption, and other similar taxes. If Owner and Contractor are unable to agree on entitlement to or on the amount or extent, if any, of any adjustment in Contract Price or Contract Times resulting from such changes, then within 30 days of such written notice Contractor may submit a Change Proposal, or Owner may initiate a Claim.

7.12 *Record Documents*

A. Contractor shall maintain in a safe place at the Site one printed record copy of all Drawings, Specifications, Addenda, Change Orders, Work Change Directives, Field Orders, written interpretations and clarifications, and approved Shop Drawings. Contractor shall keep such record documents in good order and annotate them to show changes made during construction. These record documents, together with all approved Samples, will be available to Engineer for reference. Upon completion of the Work, Contractor shall deliver these record documents to Engineer.

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7.13 *Safety and Protection*

A. Contractor shall be solely responsible for initiating, maintaining, and supervising all safety precautions and programs in connection with the Work. Such responsibility does not relieve Subcontractors of their responsibility for the safety of persons or property in the performance of their work, nor for compliance with applicable safety Laws and Regulations.

B. Contractor shall designate a qualified and experienced safety representative whose duties and responsibilities are the prevention of Work-related accidents and the maintenance and supervision of safety precautions and programs.

C. Contractor shall take all necessary precautions for the safety of, and shall provide the necessary protection to prevent damage, injury, or loss to:

1. all persons on the Site or who may be affected by the Work;

2. all the Work and materials and equipment to be incorporated therein, whether in storage on or off the Site; and

3. other property at the Site or adjacent thereto, including trees, shrubs, lawns, walks, pavements, roadways, structures, other work in progress, utilities, and Underground Facilities not designated for removal, relocation, or replacement in the course of construction.

D. All damage, injury, or loss to any property referred to in Paragraph 7.13.C.2 or 7.13.C.3 caused, directly or indirectly, in whole or in part, by Contractor, any Subcontractor, Supplier, or any other individual or entity directly or indirectly employed by any of them to perform any of the Work, or anyone for whose acts any of them may be liable, shall be remedied by Contractor at its expense (except damage or loss attributable to the fault of Drawings or Specifications or to the acts or omissions of Owner or Engineer or anyone employed by any of them, or anyone for whose acts any of them may be liable, and not attributable, directly or indirectly, in whole or in part, to the fault or negligence of Contractor or any Subcontractor, Supplier, or other individual or entity directly or indirectly employed by any of them).

E. Contractor shall comply with all applicable Laws and Regulations relating to the safety of persons or property, or to the protection of persons or property from damage, injury, or loss; and shall erect and maintain all necessary safeguards for such safety and protection.

F. Contractor shall notify Owner; the owners of adjacent property; the owners of Underground Facilities and other utilities (if the identity of such owners is known to Contractor); and other contractors and utility owners performing work at or adjacent to the Site, in writing, when Contractor knows that prosecution of the Work may affect them, and shall cooperate with them in the protection, removal, relocation, and replacement of their property or work in progress.

G. Contractor shall comply with the applicable requirements of Owner's safety programs, if any. Any Owner's safety programs that are applicable to the Work are identified or included in the Supplementary Conditions or Specifications.

H. Contractor shall inform Owner and Engineer of the specific requirements of Contractor's safety program with which Owner's and Engineer's employees and representatives must comply while at the Site.

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I. Contractor's duties and responsibilities for safety and protection will continue until all the Work is completed, Engineer has issued a written notice to Owner and Contractor in accordance with Paragraph 15.06.C that the Work is acceptable, and Contractor has left the Site (except as otherwise expressly provided in connection with Substantial Completion).

J. Contractor's duties and responsibilities for safety and protection will resume whenever Contractor or any Subcontractor or Supplier returns to the Site to fulfill warranty or correction obligations, or to conduct other tasks arising from the Contract Documents.

7.14 *Hazard Communication Programs*

A. Contractor shall be responsible for coordinating any exchange of safety data sheets (formerly known as material safety data sheets) or other hazard communication information required to be made available to or exchanged between or among employers at the Site in accordance with Laws or Regulations.

7.15 *Emergencies*

A. In emergencies affecting the safety or protection of persons or the Work or property at the Site or adjacent thereto, Contractor is obligated to act to prevent damage, injury, or loss. Contractor shall give Engineer prompt written notice if Contractor believes that any significant changes in the Work or variations from the Contract Documents have been caused by an emergency, or are required as a result of Contractor's response to an emergency. If Engineer determines that a change in the Contract Documents is required because of an emergency or Contractor's response, a Work Change Directive or Change Order will be issued.

7.16 *Submittals*

A. *Shop Drawing and Sample Requirements*

1. Before submitting a Shop Drawing or Sample, Contractor shall:

a. review and coordinate the Shop Drawing or Sample with other Shop Drawings and Samples and with the requirements of the Work and the Contract Documents;

b. determine and verify:

1) all field measurements, quantities, dimensions, specified performance and design criteria, installation requirements, materials, catalog numbers, and similar information with respect to the Submittal;

2) the suitability of all materials and equipment offered with respect to the indicated application, fabrication, shipping, handling, storage, assembly, and installation pertaining to the performance of the Work; and

3) all information relative to Contractor's responsibilities for means, methods, techniques, sequences, and procedures of construction, and safety precautions and programs incident thereto;

c. confirm that the Submittal is complete with respect to all related data included in the Submittal.

2. Each Shop Drawing or Sample must bear a stamp or specific written certification that Contractor has satisfied Contractor's obligations under the Contract Documents with respect to Contractor's review of that Submittal, and that Contractor approves the Submittal.

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3. With each Shop Drawing or Sample, Contractor shall give Engineer specific written notice of any variations that the Submittal may have from the requirements of the Contract Documents. This notice must be set forth in a written communication separate from the Submittal; and, in addition, in the case of a Shop Drawing by a specific notation made on the Shop Drawing itself.

B. *Submittal Procedures for Shop Drawings and Samples*: Contractor shall label and submit Shop Drawings and Samples to Engineer for review and approval in accordance with the accepted Schedule of Submittals.

1. *Shop Drawings*

a. Contractor shall submit the number of copies required in the Specifications.

b. Data shown on the Shop Drawings must be complete with respect to quantities, dimensions, specified performance and design criteria, materials, and similar data to show Engineer the services, materials, and equipment Contractor proposes to provide, and to enable Engineer to review the information for the limited purposes required by Paragraph 7.16.C.

2. *Samples*

a. Contractor shall submit the number of Samples required in the Specifications.

b. Contractor shall clearly identify each Sample as to material, Supplier, pertinent data such as catalog numbers, the use for which intended and other data as Engineer may require to enable Engineer to review the Submittal for the limited purposes required by Paragraph 7.16.C.

3. Where a Shop Drawing or Sample is required by the Contract Documents or the Schedule of Submittals, any related Work performed prior to Engineer's review and approval of the pertinent submittal will be at the sole expense and responsibility of Contractor.

C. *Engineer's Review of Shop Drawings and Samples*

1. Engineer will provide timely review of Shop Drawings and Samples in accordance with the accepted Schedule of Submittals. Engineer's review and approval will be only to determine if the items covered by the Submittals will, after installation or incorporation in the Work, comply with the requirements of the Contract Documents, and be compatible with the design concept of the completed Project as a functioning whole as indicated by the Contract Documents.

2. Engineer's review and approval will not extend to means, methods, techniques, sequences, or procedures of construction, or to safety precautions or programs incident thereto.

3. Engineer's review and approval of a separate item as such will not indicate approval of the assembly in which the item functions.

4. Engineer's review and approval of a Shop Drawing or Sample will not relieve Contractor from responsibility for any variation from the requirements of the Contract Documents unless Contractor has complied with the requirements of Paragraph 7.16.A.3 and Engineer has given written approval of each such variation by specific written notation thereof incorporated in or accompanying the Shop Drawing or Sample. Engineer will

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document any such approved variation from the requirements of the Contract Documents in a Field Order or other appropriate Contract modification.

5. Engineer's review and approval of a Shop Drawing or Sample will not relieve Contractor from responsibility for complying with the requirements of Paragraphs 7.16.A and B.

6. Engineer's review and approval of a Shop Drawing or Sample, or of a variation from the requirements of the Contract Documents, will not, under any circumstances, change the Contract Times or Contract Price, unless such changes are included in a Change Order.

7. Neither Engineer's receipt, review, acceptance, or approval of a Shop Drawing or Sample will result in such item becoming a Contract Document.

8. Contractor shall perform the Work in compliance with the requirements and commitments set forth in approved Shop Drawings and Samples, subject to the provisions of Paragraph 7.16.C.4.

D. *Resubmittal Procedures for Shop Drawings and Samples*

1. Contractor shall make corrections required by Engineer and shall return the required number of corrected copies of Shop Drawings and submit, as required, new Samples for review and approval. Contractor shall direct specific attention in writing to revisions other than the corrections called for by Engineer on previous Submittals.

2. Contractor shall furnish required Shop Drawing and Sample submittals with sufficient information and accuracy to obtain required approval of an item with no more than two resubmittals. Engineer will record Engineer's time for reviewing a third or subsequent resubmittal of a Shop Drawing or Sample, and Contractor shall be responsible for Engineer's charges to Owner for such time. Owner may impose a set-off against payments due Contractor to secure reimbursement for such charges.

3. If Contractor requests a change of a previously approved Shop Drawing or Sample, Contractor shall be responsible for Engineer's charges to Owner for its review time, and Owner may impose a set-off against payments due Contractor to secure reimbursement for such charges, unless the need for such change is beyond the control of Contractor.

E. *Submittals Other than Shop Drawings, Samples, and Owner-Delegated Designs*

1. The following provisions apply to all Submittals other than Shop Drawings, Samples, and Owner-delegated designs:

   a. Contractor shall submit all such Submittals to the Engineer in accordance with the Schedule of Submittals and pursuant to the applicable terms of the Contract Documents.

   b. Engineer will provide timely review of all such Submittals in accordance with the Schedule of Submittals and return such Submittals with a notation of either Accepted or Not Accepted. Any such Submittal that is not returned within the time established in the Schedule of Submittals will be deemed accepted.

   c. Engineer's review will be only to determine if the Submittal is acceptable under the requirements of the Contract Documents as to general form and content of the Submittal.

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d. If any such Submittal is not accepted, Contractor shall confer with Engineer regarding the reason for the non-acceptance, and resubmit an acceptable document.

2. Procedures for the submittal and acceptance of the Progress Schedule, the Schedule of Submittals, and the Schedule of Values are set forth in Paragraphs 2.03. 2.04, and 2.05.

F. Owner-delegated Designs: Submittals pursuant to Owner-delegated designs are governed by the provisions of Paragraph 7.19.

7.17 *Contractor's General Warranty and Guarantee*

A. Contractor warrants and guarantees to Owner that all Work will be in accordance with the Contract Documents and will not be defective. Engineer is entitled to rely on Contractor's warranty and guarantee.

B. Owner's rights under this warranty and guarantee are in addition to, and are not limited by, Owner's rights under the correction period provisions of Paragraph 15.08. The time in which Owner may enforce its warranty and guarantee rights under this Paragraph 7.17 is limited only by applicable Laws and Regulations restricting actions to enforce such rights; provided, however, that after the end of the correction period under Paragraph 15.08:

1. Owner shall give Contractor written notice of any defective Work within 60 days of the discovery that such Work is defective; and

2. Such notice will be deemed the start of an event giving rise to a Claim under Paragraph 12.01.B, such that any related Claim must be brought within 30 days of the notice.

C. Contractor's warranty and guarantee hereunder excludes defects or damage caused by:

1. abuse, or improper modification, maintenance, or operation, by persons other than Contractor, Subcontractors, Suppliers, or any other individual or entity for whom Contractor is responsible; or

2. normal wear and tear under normal usage.

D. Contractor's obligation to perform and complete the Work in accordance with the Contract Documents is absolute. None of the following will constitute an acceptance of Work that is not in accordance with the Contract Documents, a release of Contractor's obligation to perform the Work in accordance with the Contract Documents, or a release of Owner's warranty and guarantee rights under this Paragraph 7.17:

1. Observations by Engineer;

2. Recommendation by Engineer or payment by Owner of any progress or final payment;

3. The issuance of a certificate of Substantial Completion by Engineer or any payment related thereto by Owner;

4. Use or occupancy of the Work or any part thereof by Owner;

5. Any review and approval of a Shop Drawing or Sample submittal;

6. The issuance of a notice of acceptability by Engineer;

7. The end of the correction period established in Paragraph 15.08;

8. Any inspection, test, or approval by others; or

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9. Any correction of defective Work by Owner.

E. If the Contract requires the Contractor to accept the assignment of a contract entered into by Owner, then the specific warranties, guarantees, and correction obligations contained in the assigned contract will govern with respect to Contractor's performance obligations to Owner for the Work described in the assigned contract.

7.18 *Indemnification*

A. To the fullest extent permitted by Laws and Regulations, and in addition to any other obligations of Contractor under the Contract or otherwise, Contractor shall indemnify and hold harmless Owner and Engineer, and the officers, directors, members, partners, employees, agents, consultants and subcontractors of each and any of them, from losses, damages, costs, and judgments (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals, and all court or arbitration or other dispute resolution costs) arising from third-party claims or actions relating to or resulting from the performance or furnishing of the Work, provided that any such claim, action, loss, cost, judgment or damage is attributable to bodily injury, sickness, disease, or death, or to damage to or destruction of tangible property (other than the Work itself), including the loss of use resulting therefrom, but only to the extent caused by any negligent act or omission of Contractor, any Subcontractor, any Supplier, or any individual or entity directly or indirectly employed by any of them to perform any of the Work, or anyone for whose acts any of them may be liable.

B. In any and all claims against Owner or Engineer, or any of their officers, directors, members, partners, employees, agents, consultants, or subcontractors, by any employee (or the survivor or personal representative of such employee) of Contractor, any Subcontractor, any Supplier, or any individual or entity directly or indirectly employed by any of them to perform any of the Work, or anyone for whose acts any of them may be liable, the indemnification obligation under Paragraph 7.18.A will not be limited in any way by any limitation on the amount or type of damages, compensation, or benefits payable by or for Contractor or any such Subcontractor, Supplier, or other individual or entity under workers' compensation acts, disability benefit acts, or other employee benefit acts.

7.19 *Delegation of Professional Design Services*

A. Owner may require Contractor to provide professional design services for a portion of the Work by express delegation in the Contract Documents. Such delegation will specify the performance and design criteria that such services must satisfy, and the Submittals that Contractor must furnish to Engineer with respect to the Owner-delegated design.

B. Contractor shall cause such Owner-delegated professional design services to be provided pursuant to the professional standard of care by a properly licensed design professional, whose signature and seal must appear on all drawings, calculations, specifications, certifications, and Submittals prepared by such design professional. Such design professional must issue all certifications of design required by Laws and Regulations.

C. If a Shop Drawing or other Submittal related to the Owner-delegated design is prepared by Contractor, a Subcontractor, or others for submittal to Engineer, then such Shop Drawing or other Submittal must bear the written approval of Contractor's design professional when submitted by Contractor to Engineer.

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D. Owner and Engineer shall be entitled to rely upon the adequacy, accuracy, and completeness of the services, certifications, and approvals performed or provided by the design professionals retained or employed by Contractor under an Owner-delegated design, subject to the professional standard of care and the performance and design criteria stated in the Contract Documents.

E. Pursuant to this Paragraph 7.19, Engineer's review, approval, and other determinations regarding design drawings, calculations, specifications, certifications, and other Submittals furnished by Contractor pursuant to an Owner-delegated design will be only for the following limited purposes:

1. Checking for conformance with the requirements of this Paragraph 7.19;

2. Confirming that Contractor (through its design professionals) has used the performance and design criteria specified in the Contract Documents; and

3. Establishing that the design furnished by Contractor is consistent with the design concept expressed in the Contract Documents.

F. Contractor shall not be responsible for the adequacy of performance or design criteria specified by Owner or Engineer.

G. Contractor is not required to provide professional services in violation of applicable Laws and Regulations.

ARTICLE 8—OTHER WORK AT THE SITE

8.01 *Other Work*

A. In addition to and apart from the Work under the Contract Documents, the Owner may perform other work at or adjacent to the Site. Such other work may be performed by Owner's employees, or through contracts between the Owner and third parties. Owner may also arrange to have third-party utility owners perform work on their utilities and facilities at or adjacent to the Site.

B. If Owner performs other work at or adjacent to the Site with Owner's employees, or through contracts for such other work, then Owner shall give Contractor written notice thereof prior to starting any such other work. If Owner has advance information regarding the start of any third-party utility work that Owner has arranged to take place at or adjacent to the Site, Owner shall provide such information to Contractor.

C. Contractor shall afford proper and safe access to the Site to each contractor that performs such other work, each utility owner performing other work, and Owner, if Owner is performing other work with Owner's employees, and provide a reasonable opportunity for the introduction and storage of materials and equipment and the execution of such other work.

D. Contractor shall do all cutting, fitting, and patching of the Work that may be required to properly connect or otherwise make its several parts come together and properly integrate with such other work. Contractor shall not endanger any work of others by cutting, excavating, or otherwise altering such work; provided, however, that Contractor may cut or alter others' work with the written consent of Engineer and the others whose work will be affected.

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E. If the proper execution or results of any part of Contractor's Work depends upon work performed by others, Contractor shall inspect such other work and promptly report to Engineer in writing any delays, defects, or deficiencies in such other work that render it unavailable or unsuitable for the proper execution and results of Contractor's Work. Contractor's failure to so report will constitute an acceptance of such other work as fit and proper for integration with Contractor's Work except for latent defects and deficiencies in such other work.

F. The provisions of this article are not applicable to work that is performed by third-party utilities or other third-party entities without a contract with Owner, or that is performed without having been arranged by Owner. If such work occurs, then any related delay, disruption, or interference incurred by Contractor is governed by the provisions of Paragraph 4.05.C.3.

8.02 *Coordination*

A. If Owner intends to contract with others for the performance of other work at or adjacent to the Site, to perform other work at or adjacent to the Site with Owner's employees, or to arrange to have utility owners perform work at or adjacent to the Site, the following will be set forth in the Supplementary Conditions or provided to Contractor prior to the start of any such other work:

1. The identity of the individual or entity that will have authority and responsibility for coordination of the activities among the various contractors;

2. An itemization of the specific matters to be covered by such authority and responsibility; and

3. The extent of such authority and responsibilities.

B. Unless otherwise provided in the Supplementary Conditions, Owner shall have sole authority and responsibility for such coordination.

8.03 *Legal Relationships*

A. If, in the course of performing other work for Owner at or adjacent to the Site, the Owner's employees, any other contractor working for Owner, or any utility owner that Owner has arranged to perform work, causes damage to the Work or to the property of Contractor or its Subcontractors, or delays, disrupts, interferes with, or increases the scope or cost of the performance of the Work, through actions or inaction, then Contractor shall be entitled to an equitable adjustment in the Contract Price or the Contract Times. Contractor must submit any Change Proposal seeking an equitable adjustment in the Contract Price or the Contract Times under this paragraph within 30 days of the damaging, delaying, disrupting, or interfering event. The entitlement to, and extent of, any such equitable adjustment will take into account information (if any) regarding such other work that was provided to Contractor in the Contract Documents prior to the submittal of the Bid or the final negotiation of the terms of the Contract, and any remedies available to Contractor under Laws or Regulations concerning utility action or inaction. When applicable, any such equitable adjustment in Contract Price will be conditioned on Contractor assigning to Owner all Contractor's rights against such other contractor or utility owner with respect to the damage, delay, disruption, or interference that is the subject of the adjustment. Contractor's entitlement to an adjustment of the Contract Times or Contract Price is subject to the provisions of Paragraphs 4.05.D and 4.05.E.

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B. Contractor shall take reasonable and customary measures to avoid damaging, delaying, disrupting, or interfering with the work of Owner, any other contractor, or any utility owner performing other work at or adjacent to the Site.

1. If Contractor fails to take such measures and as a result damages, delays, disrupts, or interferes with the work of any such other contractor or utility owner, then Owner may impose a set-off against payments due Contractor, and assign to such other contractor or utility owner the Owner's contractual rights against Contractor with respect to the breach of the obligations set forth in this Paragraph 8.03.B.

2. When Owner is performing other work at or adjacent to the Site with Owner's employees, Contractor shall be liable to Owner for damage to such other work, and for the reasonable direct delay, disruption, and interference costs incurred by Owner as a result of Contractor's failure to take reasonable and customary measures with respect to Owner's other work. In response to such damage, delay, disruption, or interference, Owner may impose a set-off against payments due Contractor.

C. If Contractor damages, delays, disrupts, or interferes with the work of any other contractor, or any utility owner performing other work at or adjacent to the Site, through Contractor's failure to take reasonable and customary measures to avoid such impacts, or if any claim arising out of Contractor's actions, inactions, or negligence in performance of the Work at or adjacent to the Site is made by any such other contractor or utility owner against Contractor, Owner, or Engineer, then Contractor shall (1) promptly attempt to settle the claim as to all parties through negotiations with such other contractor or utility owner, or otherwise resolve the claim by arbitration or other dispute resolution proceeding or at law, and (2) indemnify and hold harmless Owner and Engineer, and the officers, directors, members, partners, employees, agents, consultants and subcontractors of each and any of them from and against any such claims, and against all costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to such damage, delay, disruption, or interference.

ARTICLE 9—OWNER'S RESPONSIBILITIES

9.01 *Communications to Contractor*

A. Except as otherwise provided in these General Conditions, Owner shall issue all communications to Contractor through Engineer.

9.02 *Replacement of Engineer*

A. Owner may at its discretion appoint an engineer to replace Engineer, provided Contractor makes no reasonable objection to the replacement engineer. The replacement engineer's status under the Contract Documents will be that of the former Engineer.

9.03 *Furnish Data*

A. Owner shall promptly furnish the data required of Owner under the Contract Documents.

9.04 *Pay When Due*

A. Owner shall make payments to Contractor when they are due as provided in the Agreement.

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9.05 *Lands and Easements; Reports, Tests, and Drawings*

A. Owner's duties with respect to providing lands and easements are set forth in Paragraph 5.01.

B. Owner's duties with respect to providing engineering surveys to establish reference points are set forth in Paragraph 4.03.

C. Article 5 refers to Owner's identifying and making available to Contractor copies of reports of explorations and tests of conditions at the Site, and drawings of physical conditions relating to existing surface or subsurface structures at the Site.

9.06 *Insurance*

A. Owner's responsibilities, if any, with respect to purchasing and maintaining liability and property insurance are set forth in Article 6.

9.07 *Change Orders*

A. Owner's responsibilities with respect to Change Orders are set forth in Article 11.

9.08 *Inspections, Tests, and Approvals*

A. Owner's responsibility with respect to certain inspections, tests, and approvals is set forth in Paragraph 14.02.B.

9.09 *Limitations on Owner's Responsibilities*

A. The Owner shall not supervise, direct, or have control or authority over, nor be responsible for, Contractor's means, methods, techniques, sequences, or procedures of construction, or the safety precautions and programs incident thereto, or for any failure of Contractor to comply with Laws and Regulations applicable to the performance of the Work. Owner will not be responsible for Contractor's failure to perform the Work in accordance with the Contract Documents.

9.10 *Undisclosed Hazardous Environmental Condition*

A. Owner's responsibility in respect to an undisclosed Hazardous Environmental Condition is set forth in Paragraph 5.06.

9.11 *Evidence of Financial Arrangements*

A. Upon request of Contractor, Owner shall furnish Contractor reasonable evidence that financial arrangements have been made to satisfy Owner's obligations under the Contract (including obligations under proposed changes in the Work).

9.12 *Safety Programs*

A. While at the Site, Owner's employees and representatives shall comply with the specific applicable requirements of Contractor's safety programs of which Owner has been informed.

B. Owner shall furnish copies of any applicable Owner safety programs to Contractor.

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ARTICLE 10—ENGINEER'S STATUS DURING CONSTRUCTION

10.01 *Owner's Representative*

A. Engineer will be Owner's representative during the construction period. The duties and responsibilities and the limitations of authority of Engineer as Owner's representative during construction are set forth in the Contract.

10.02 *Visits to Site*

A. Engineer will make visits to the Site at intervals appropriate to the various stages of construction as Engineer deems necessary in order to observe, as an experienced and qualified design professional, the progress that has been made and the quality of the various aspects of Contractor's executed Work. Based on information obtained during such visits and observations, Engineer, for the benefit of Owner, will determine, in general, if the Work is proceeding in accordance with the Contract Documents. Engineer will not be required to make exhaustive or continuous inspections on the Site to check the quality or quantity of the Work. Engineer's efforts will be directed toward providing for Owner a greater degree of confidence that the completed Work will conform generally to the Contract Documents. On the basis of such visits and observations, Engineer will keep Owner informed of the progress of the Work and will endeavor to guard Owner against defective Work.

B. Engineer's visits and observations are subject to all the limitations on Engineer's authority and responsibility set forth in Paragraph 10.07. Particularly, but without limitation, during or as a result of Engineer's visits or observations of Contractor's Work, Engineer will not supervise, direct, control, or have authority over or be responsible for Contractor's means, methods, techniques, sequences, or procedures of construction, or the safety precautions and programs incident thereto, or for any failure of Contractor to comply with Laws and Regulations applicable to the performance of the Work.

10.03 *Resident Project Representative*

A. If Owner and Engineer have agreed that Engineer will furnish a Resident Project Representative to represent Engineer at the Site and assist Engineer in observing the progress and quality of the Work, then the authority and responsibilities of any such Resident Project Representative will be as provided in the Supplementary Conditions, and limitations on the responsibilities thereof will be as provided in the Supplementary Conditions and in Paragraph 10.07.

B. If Owner designates an individual or entity who is not Engineer's consultant, agent, or employee to represent Owner at the Site, then the responsibilities and authority of such individual or entity will be as provided in the Supplementary Conditions.

10.04 *Engineer's Authority*

A. Engineer has the authority to reject Work in accordance with Article 14.

B. Engineer's authority as to Submittals is set forth in Paragraph 7.16.

C. Engineer's authority as to design drawings, calculations, specifications, certifications and other Submittals from Contractor in response to Owner's delegation (if any) to Contractor of professional design services, is set forth in Paragraph 7.19.

D. Engineer's authority as to changes in the Work is set forth in Article 11.

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E. Engineer's authority as to Applications for Payment is set forth in Article 15.

10.05 *Determinations for Unit Price Work*

A. Engineer will determine the actual quantities and classifications of Unit Price Work performed by Contractor as set forth in Paragraph 13.03.

10.06 *Decisions on Requirements of Contract Documents and Acceptability of Work*

A. Engineer will render decisions regarding the requirements of the Contract Documents, and judge the acceptability of the Work, pursuant to the specific procedures set forth herein for initial interpretations, Change Proposals, and acceptance of the Work. In rendering such decisions and judgments, Engineer will not show partiality to Owner or Contractor, and will not be liable to Owner, Contractor, or others in connection with any proceedings, interpretations, decisions, or judgments conducted or rendered in good faith.

10.07 *Limitations on Engineer's Authority and Responsibilities*

A. Neither Engineer's authority or responsibility under this Article 10 or under any other provision of the Contract, nor any decision made by Engineer in good faith either to exercise or not exercise such authority or responsibility or the undertaking, exercise, or performance of any authority or responsibility by Engineer, will create, impose, or give rise to any duty in contract, tort, or otherwise owed by Engineer to Contractor, any Subcontractor, any Supplier, any other individual or entity, or to any surety for or employee or agent of any of them.

B. Engineer will not supervise, direct, control, or have authority over or be responsible for Contractor's means, methods, techniques, sequences, or procedures of construction, or the safety precautions and programs incident thereto, or for any failure of Contractor to comply with Laws and Regulations applicable to the performance of the Work. Engineer will not be responsible for Contractor's failure to perform the Work in accordance with the Contract Documents.

C. Engineer will not be responsible for the acts or omissions of Contractor or of any Subcontractor, any Supplier, or of any other individual or entity performing any of the Work.

D. Engineer's review of the final Application for Payment and accompanying documentation, and all maintenance and operating instructions, schedules, guarantees, bonds, certificates of inspection, tests and approvals, and other documentation required to be delivered by Contractor under Paragraph 15.06.A, will only be to determine generally that their content complies with the requirements of, and in the case of certificates of inspections, tests, and approvals, that the results certified indicate compliance with the Contract Documents.

E. The limitations upon authority and responsibility set forth in this Paragraph 10.07 also apply to the Resident Project Representative, if any.

10.08 *Compliance with Safety Program*

A. While at the Site, Engineer's employees and representatives will comply with the specific applicable requirements of Owner's and Contractor's safety programs of which Engineer has been informed.

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ARTICLE 11—CHANGES TO THE CONTRACT

11.01 *Amending and Supplementing the Contract*

A. The Contract may be amended or supplemented by a Change Order, a Work Change Directive, or a Field Order.

B. If an amendment or supplement to the Contract includes a change in the Contract Price or the Contract Times, such amendment or supplement must be set forth in a Change Order.

C. All changes to the Contract that involve (1) the performance or acceptability of the Work, (2) the design (as set forth in the Drawings, Specifications, or otherwise), or (3) other engineering or technical matters, must be supported by Engineer's recommendation. Owner and Contractor may amend other terms and conditions of the Contract without the recommendation of the Engineer.

11.02 *Change Orders*

A. Owner and Contractor shall execute appropriate Change Orders covering:

1. Changes in Contract Price or Contract Times which are agreed to by the parties, including any undisputed sum or amount of time for Work actually performed in accordance with a Work Change Directive;

2. Changes in Contract Price resulting from an Owner set-off, unless Contractor has duly contested such set-off;

3. Changes in the Work which are: (a) ordered by Owner pursuant to Paragraph 11.05, (b) required because of Owner's acceptance of defective Work under Paragraph 14.04 or Owner's correction of defective Work under Paragraph 14.07, or (c) agreed to by the parties, subject to the need for Engineer's recommendation if the change in the Work involves the design (as set forth in the Drawings, Specifications, or otherwise) or other engineering or technical matters; and

4. Changes that embody the substance of any final and binding results under: Paragraph 11.03.B, resolving the impact of a Work Change Directive; Paragraph 11.09, concerning Change Proposals; Article 12, Claims; Paragraph 13.02.D, final adjustments resulting from allowances; Paragraph 13.03.D, final adjustments relating to determination of quantities for Unit Price Work; and similar provisions.

B. If Owner or Contractor refuses to execute a Change Order that is required to be executed under the terms of Paragraph 11.02.A, it will be deemed to be of full force and effect, as if fully executed.

11.03 *Work Change Directives*

A. A Work Change Directive will not change the Contract Price or the Contract Times but is evidence that the parties expect that the modification ordered or documented by a Work Change Directive will be incorporated in a subsequently issued Change Order, following negotiations by the parties as to the Work Change Directive's effect, if any, on the Contract Price and Contract Times; or, if negotiations are unsuccessful, by a determination under the terms of the Contract Documents governing adjustments, expressly including Paragraph 11.07 regarding change of Contract Price.

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B. If Owner has issued a Work Change Directive and:

1. Contractor believes that an adjustment in Contract Times or Contract Price is necessary, then Contractor shall submit any Change Proposal seeking such an adjustment no later than 30 days after the completion of the Work set out in the Work Change Directive.

2. Owner believes that an adjustment in Contract Times or Contract Price is necessary, then Owner shall submit any Claim seeking such an adjustment no later than 60 days after issuance of the Work Change Directive.

11.04 *Field Orders*

A. Engineer may authorize minor changes in the Work if the changes do not involve an adjustment in the Contract Price or the Contract Times and are compatible with the design concept of the completed Project as a functioning whole as indicated by the Contract Documents. Such changes will be accomplished by a Field Order and will be binding on Owner and also on Contractor, which shall perform the Work involved promptly.

B. If Contractor believes that a Field Order justifies an adjustment in the Contract Price or Contract Times, then before proceeding with the Work at issue, Contractor shall submit a Change Proposal as provided herein.

11.05 *Owner-Authorized Changes in the Work*

A. Without invalidating the Contract and without notice to any surety, Owner may, at any time or from time to time, order additions, deletions, or revisions in the Work. Changes involving the design (as set forth in the Drawings, Specifications, or otherwise) or other engineering or technical matters will be supported by Engineer's recommendation.

B. Such changes in the Work may be accomplished by a Change Order, if Owner and Contractor have agreed as to the effect, if any, of the changes on Contract Times or Contract Price; or by a Work Change Directive. Upon receipt of any such document, Contractor shall promptly proceed with the Work involved; or, in the case of a deletion in the Work, promptly cease construction activities with respect to such deleted Work. Added or revised Work must be performed under the applicable conditions of the Contract Documents.

C. Nothing in this Paragraph 11.05 obligates Contractor to undertake work that Contractor reasonably concludes cannot be performed in a manner consistent with Contractor's safety obligations under the Contract Documents or Laws and Regulations.

11.06 *Unauthorized Changes in the Work*

A. Contractor shall not be entitled to an increase in the Contract Price or an extension of the Contract Times with respect to any work performed that is not required by the Contract Documents, as amended, modified, or supplemented, except in the case of an emergency as provided in Paragraph 7.15 or in the case of uncovering Work as provided in Paragraph 14.05.C.2.

11.07 *Change of Contract Price*

A. The Contract Price may only be changed by a Change Order. Any Change Proposal for an adjustment in the Contract Price must comply with the provisions of Paragraph 11.09. Any Claim for an adjustment of Contract Price must comply with the provisions of Article 12.

B. An adjustment in the Contract Price will be determined as follows:

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1. Where the Work involved is covered by unit prices contained in the Contract Documents, then by application of such unit prices to the quantities of the items involved (subject to the provisions of Paragraph 13.03);

2. Where the Work involved is not covered by unit prices contained in the Contract Documents, then by a mutually agreed lump sum (which may include an allowance for overhead and profit not necessarily in accordance with Paragraph 11.07.C.2); or

3. Where the Work involved is not covered by unit prices contained in the Contract Documents and the parties do not reach mutual agreement to a lump sum, then on the basis of the Cost of the Work (determined as provided in Paragraph 13.01) plus a Contractor's fee for overhead and profit (determined as provided in Paragraph 11.07.C).

C. *Contractor's Fee*: When applicable, the Contractor's fee for overhead and profit will be determined as follows:

1. A mutually acceptable fixed fee; or

2. If a fixed fee is not agreed upon, then a fee based on the following percentages of the various portions of the Cost of the Work:

a. For costs incurred under Paragraphs 13.01.B.1 and 13.01.B.2, the Contractor's fee will be 15 percent;

b. For costs incurred under Paragraph 13.01.B.3, the Contractor's fee will be 5 percent;

c. Where one or more tiers of subcontracts are on the basis of Cost of the Work plus a fee and no fixed fee is agreed upon, the intent of Paragraphs 11.07.C.2.a and 11.07.C.2.b is that the Contractor's fee will be based on: (1) a fee of 15 percent of the costs incurred under Paragraphs 13.01.B.1 and 13.01.B.2 by the Subcontractor that actually performs the Work, at whatever tier, and (2) with respect to Contractor itself and to any Subcontractors of a tier higher than that of the Subcontractor that actually performs the Work, a fee of 5 percent of the amount (fee plus underlying costs incurred) attributable to the next lower tier Subcontractor; provided, however, that for any such subcontracted Work the maximum total fee to be paid by Owner will be no greater than 27 percent of the costs incurred by the Subcontractor that actually performs the Work;

d. No fee will be payable on the basis of costs itemized under Paragraphs 13.01.B.4, 13.01.B.5, and 13.01.C;

e. The amount of credit to be allowed by Contractor to Owner for any change which results in a net decrease in Cost of the Work will be the amount of the actual net decrease in Cost of the Work and a deduction of an additional amount equal to 5 percent of such actual net decrease in Cost of the Work; and

f. When both additions and credits are involved in any one change or Change Proposal, the adjustment in Contractor's fee will be computed by determining the sum of the costs in each of the cost categories in Paragraph 13.01.B (specifically, payroll costs, Paragraph 13.01.B.1; incorporated materials and equipment costs, Paragraph 13.01.B.2; Subcontract costs, Paragraph 13.01.B.3; special consultants costs, Paragraph 13.01.B.4; and other costs, Paragraph 13.01.B.5) and applying to each such cost category sum the appropriate fee from Paragraphs 11.07.C.2.a through 11.07.C.2.e, inclusive.

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11.08 *Change of Contract Times*

A. The Contract Times may only be changed by a Change Order. Any Change Proposal for an adjustment in the Contract Times must comply with the provisions of Paragraph 11.09. Any Claim for an adjustment in the Contract Times must comply with the provisions of Article 12.

B. Delay, disruption, and interference in the Work, and any related changes in Contract Times, are addressed in and governed by Paragraph 4.05.

11.09 *Change Proposals*

A. *Purpose and Content*: Contractor shall submit a Change Proposal to Engineer to request an adjustment in the Contract Times or Contract Price; contest an initial decision by Engineer concerning the requirements of the Contract Documents or relating to the acceptability of the Work under the Contract Documents; challenge a set-off against payment due; or seek other relief under the Contract. The Change Proposal will specify any proposed change in Contract Times or Contract Price, or other proposed relief, and explain the reason for the proposed change, with citations to any governing or applicable provisions of the Contract Documents. Each Change Proposal will address only one issue, or a set of closely related issues.

B. *Change Proposal Procedures*

1. *Submittal*: Contractor shall submit each Change Proposal to Engineer within 30 days after the start of the event giving rise thereto, or after such initial decision.

2. *Supporting Data*: The Contractor shall submit supporting data, including the proposed change in Contract Price or Contract Time (if any), to the Engineer and Owner within 15 days after the submittal of the Change Proposal.

    a. Change Proposals based on or related to delay, interruption, or interference must comply with the provisions of Paragraphs 4.05.D and 4.05.E.

    b. Change proposals related to a change of Contract Price must include full and detailed accounts of materials incorporated into the Work and labor and equipment used for the subject Work.

    The supporting data must be accompanied by a written statement that the supporting data are accurate and complete, and that any requested time or price adjustment is the entire adjustment to which Contractor believes it is entitled as a result of said event.

3. *Engineer's Initial Review*: Engineer will advise Owner regarding the Change Proposal, and consider any comments or response from Owner regarding the Change Proposal. If in its discretion Engineer concludes that additional supporting data is needed before conducting a full review and making a decision regarding the Change Proposal, then Engineer may request that Contractor submit such additional supporting data by a date specified by Engineer, prior to Engineer beginning its full review of the Change Proposal.

4. *Engineer's Full Review and Action on the Change Proposal*: Upon receipt of Contractor's supporting data (including any additional data requested by Engineer), Engineer will conduct a full review of each Change Proposal and, within 30 days after such receipt of the Contractor's supporting data, either approve the Change Proposal in whole, deny it in whole, or approve it in part and deny it in part. Such actions must be in writing, with a copy provided to Owner and Contractor. If Engineer does not take action on the Change

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Proposal within 30 days, then either Owner or Contractor may at any time thereafter submit a letter to the other party indicating that as a result of Engineer's inaction the Change Proposal is deemed denied, thereby commencing the time for appeal of the denial under Article 12.

5. *Binding Decision*: Engineer's decision is final and binding upon Owner and Contractor, unless Owner or Contractor appeals the decision by filing a Claim under Article 12.

C. *Resolution of Certain Change Proposals*: If the Change Proposal does not involve the design (as set forth in the Drawings, Specifications, or otherwise), the acceptability of the Work, or other engineering or technical matters, then Engineer will notify the parties in writing that the Engineer is unable to resolve the Change Proposal. For purposes of further resolution of such a Change Proposal, such notice will be deemed a denial, and Contractor may choose to seek resolution under the terms of Article 12.

D. *Post-Completion*: Contractor shall not submit any Change Proposals after Engineer issues a written recommendation of final payment pursuant to Paragraph 15.06.B.

11.10 *Notification to Surety*

A. If the provisions of any bond require notice to be given to a surety of any change affecting the general scope of the Work or the provisions of the Contract Documents (including, but not limited to, Contract Price or Contract Times), the giving of any such notice will be Contractor's responsibility. The amount of each applicable bond will be adjusted to reflect the effect of any such change.

ARTICLE 12—CLAIMS

12.01 *Claims*

A. *Claims Process*: The following disputes between Owner and Contractor are subject to the Claims process set forth in this article:

1. Appeals by Owner or Contractor of Engineer's decisions regarding Change Proposals;

2. Owner demands for adjustments in the Contract Price or Contract Times, or other relief under the Contract Documents;

3. Disputes that Engineer has been unable to address because they do not involve the design (as set forth in the Drawings, Specifications, or otherwise), the acceptability of the Work, or other engineering or technical matters; and

4. Subject to the waiver provisions of Paragraph 15.07, any dispute arising after Engineer has issued a written recommendation of final payment pursuant to Paragraph 15.06.B.

B. *Submittal of Claim*: The party submitting a Claim shall deliver it directly to the other party to the Contract promptly (but in no event later than 30 days) after the start of the event giving rise thereto; in the case of appeals regarding Change Proposals within 30 days of the decision under appeal. The party submitting the Claim shall also furnish a copy to the Engineer, for its information only. The responsibility to substantiate a Claim rests with the party making the Claim. In the case of a Claim by Contractor seeking an increase in the Contract Times or Contract Price, Contractor shall certify that the Claim is made in good faith, that the supporting data are accurate and complete, and that to the best of Contractor's knowledge

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and belief the amount of time or money requested accurately reflects the full amount to which Contractor is entitled.

C. *Review and Resolution*: The party receiving a Claim shall review it thoroughly, giving full consideration to its merits. The two parties shall seek to resolve the Claim through the exchange of information and direct negotiations. The parties may extend the time for resolving the Claim by mutual agreement. All actions taken on a Claim will be stated in writing and submitted to the other party, with a copy to Engineer.

D. *Mediation*

1. At any time after initiation of a Claim, Owner and Contractor may mutually agree to mediation of the underlying dispute. The agreement to mediate will stay the Claim submittal and response process.

2. If Owner and Contractor agree to mediation, then after 60 days from such agreement, either Owner or Contractor may unilaterally terminate the mediation process, and the Claim submittal and decision process will resume as of the date of the termination. If the mediation proceeds but is unsuccessful in resolving the dispute, the Claim submittal and decision process will resume as of the date of the conclusion of the mediation, as determined by the mediator.

3. Owner and Contractor shall each pay one-half of the mediator's fees and costs.

E. *Partial Approval*: If the party receiving a Claim approves the Claim in part and denies it in part, such action will be final and binding unless within 30 days of such action the other party invokes the procedure set forth in Article 17 for final resolution of disputes.

F. *Denial of Claim*: If efforts to resolve a Claim are not successful, the party receiving the Claim may deny it by giving written notice of denial to the other party. If the receiving party does not take action on the Claim within 90 days, then either Owner or Contractor may at any time thereafter submit a letter to the other party indicating that as a result of the inaction, the Claim is deemed denied, thereby commencing the time for appeal of the denial. A denial of the Claim will be final and binding unless within 30 days of the denial the other party invokes the procedure set forth in Article 17 for the final resolution of disputes.

G. *Final and Binding Results*: If the parties reach a mutual agreement regarding a Claim, whether through approval of the Claim, direct negotiations, mediation, or otherwise; or if a Claim is approved in part and denied in part, or denied in full, and such actions become final and binding; then the results of the agreement or action on the Claim will be incorporated in a Change Order or other written document to the extent they affect the Contract, including the Work, the Contract Times, or the Contract Price.

ARTICLE 13—COST OF THE WORK; ALLOWANCES; UNIT PRICE WORK

13.01 *Cost of the Work*

A. *Purposes for Determination of Cost of the Work*: The term Cost of the Work means the sum of all costs necessary for the proper performance of the Work at issue, as further defined below. The provisions of this Paragraph 13.01 are used for two distinct purposes:

1. To determine Cost of the Work when Cost of the Work is a component of the Contract Price, under cost-plus-fee, time-and-materials, or other cost-based terms; or

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2. When needed to determine the value of a Change Order, Change Proposal, Claim, set-off, or other adjustment in Contract Price. When the value of any such adjustment is determined on the basis of Cost of the Work, Contractor is entitled only to those additional or incremental costs required because of the change in the Work or because of the event giving rise to the adjustment.

B. *Costs Included*: Except as otherwise may be agreed to in writing by Owner, costs included in the Cost of the Work will be in amounts no higher than those commonly incurred in the locality of the Project, will not include any of the costs itemized in Paragraph 13.01.C, and will include only the following items:

1. Payroll costs for employees in the direct employ of Contractor in the performance of the Work under schedules of job classifications agreed upon by Owner and Contractor in advance of the subject Work. Such employees include, without limitation, superintendents, foremen, safety managers, safety representatives, and other personnel employed full time on the Work. Payroll costs for employees not employed full time on the Work will be apportioned on the basis of their time spent on the Work. Payroll costs include, but are not limited to, salaries and wages plus the cost of fringe benefits, which include social security contributions, unemployment, excise, and payroll taxes, workers' compensation, health and retirement benefits, sick leave, and vacation and holiday pay applicable thereto. The expenses of performing Work outside of regular working hours, on Saturday, Sunday, or legal holidays, will be included in the above to the extent authorized by Owner.

2. Cost of all materials and equipment furnished and incorporated in the Work, including costs of transportation and storage thereof, and Suppliers' field services required in connection therewith. All cash discounts accrue to Contractor unless Owner deposits funds with Contractor with which to make payments, in which case the cash discounts will accrue to Owner. All trade discounts, rebates, and refunds and returns from sale of surplus materials and equipment will accrue to Owner, and Contractor shall make provisions so that they may be obtained.

3. Payments made by Contractor to Subcontractors for Work performed by Subcontractors. If required by Owner, Contractor shall obtain competitive bids from subcontractors acceptable to Owner and Contractor and shall deliver such bids to Owner, which will then determine, with the advice of Engineer, which bids, if any, will be acceptable. If any subcontract provides that the Subcontractor is to be paid on the basis of Cost of the Work plus a fee, the Subcontractor's Cost of the Work and fee will be determined in the same manner as Contractor's Cost of the Work and fee as provided in this Paragraph 13.01.

4. Costs of special consultants (including but not limited to engineers, architects, testing laboratories, surveyors, attorneys, and accountants) employed or retained for services specifically related to the Work.

5. Other costs consisting of the following:

a. The proportion of necessary transportation, travel, and subsistence expenses of Contractor's employees incurred in discharge of duties connected with the Work.

b. Cost, including transportation and maintenance, of all materials, supplies, equipment, machinery, appliances, office, and temporary facilities at the Site, which are

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consumed in the performance of the Work, and cost, less market value, of such items used but not consumed which remain the property of Contractor.

1) In establishing included costs for materials such as scaffolding, plating, or sheeting, consideration will be given to the actual or the estimated life of the material for use on other projects; or rental rates may be established on the basis of purchase or salvage value of such items, whichever is less. Contractor will not be eligible for compensation for such items in an amount that exceeds the purchase cost of such item.

c. *Construction Equipment Rental*

1) Rentals of all construction equipment and machinery, and the parts thereof, in accordance with rental agreements approved by Owner as to price (including any surcharge or special rates applicable to overtime use of the construction equipment or machinery), and the costs of transportation, loading, unloading, assembly, dismantling, and removal thereof. All such costs will be in accordance with the terms of said rental agreements. The rental of any such equipment, machinery, or parts must cease when the use thereof is no longer necessary for the Work.

2) Costs for equipment and machinery owned by Contractor or a Contractor-related entity will be paid at a rate shown for such equipment in the equipment rental rate book specified in the Supplementary Conditions. An hourly rate will be computed by dividing the monthly rates by 176. These computed rates will include all operating costs.

3) With respect to Work that is the result of a Change Order, Change Proposal, Claim, set-off, or other adjustment in Contract Price ("changed Work"), included costs will be based on the time the equipment or machinery is in use on the changed Work and the costs of transportation, loading, unloading, assembly, dismantling, and removal when directly attributable to the changed Work. The cost of any such equipment or machinery, or parts thereof, must cease to accrue when the use thereof is no longer necessary for the changed Work.

d. Sales, consumer, use, and other similar taxes related to the Work, and for which Contractor is liable, as imposed by Laws and Regulations.

e. Deposits lost for causes other than negligence of Contractor, any Subcontractor, or anyone directly or indirectly employed by any of them or for whose acts any of them may be liable, and royalty payments and fees for permits and licenses.

f. Losses and damages (and related expenses) caused by damage to the Work, not compensated by insurance or otherwise, sustained by Contractor in connection with the performance of the Work (except losses and damages within the deductible amounts of builder's risk or other property insurance established in accordance with Paragraph 6.04), provided such losses and damages have resulted from causes other than the negligence of Contractor, any Subcontractor, or anyone directly or indirectly employed by any of them or for whose acts any of them may be liable. Such losses include settlements made with the written consent and approval of Owner. No such losses, damages, and expenses will be included in the Cost of the Work for the purpose of determining Contractor's fee.

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g. The cost of utilities, fuel, and sanitary facilities at the Site.

h. Minor expenses such as communication service at the Site, express and courier services, and similar petty cash items in connection with the Work.

i. The costs of premiums for all bonds and insurance that Contractor is required by the Contract Documents to purchase and maintain.

C. *Costs Excluded*: The term Cost of the Work does not include any of the following items:

1. Payroll costs and other compensation of Contractor's officers, executives, principals, general managers, engineers, architects, estimators, attorneys, auditors, accountants, purchasing and contracting agents, expediters, timekeepers, clerks, and other personnel employed by Contractor, whether at the Site or in Contractor's principal or branch office for general administration of the Work and not specifically included in the agreed upon schedule of job classifications referred to in Paragraph 13.01.B.1 or specifically covered by Paragraph 13.01.B.4. The payroll costs and other compensation excluded here are to be considered administrative costs covered by the Contractor's fee.

2. The cost of purchasing, renting, or furnishing small tools and hand tools.

3. Expenses of Contractor's principal and branch offices other than Contractor's office at the Site.

4. Any part of Contractor's capital expenses, including interest on Contractor's capital employed for the Work and charges against Contractor for delinquent payments.

5. Costs due to the negligence of Contractor, any Subcontractor, or anyone directly or indirectly employed by any of them or for whose acts any of them may be liable, including but not limited to, the correction of defective Work, disposal of materials or equipment wrongly supplied, and making good any damage to property.

6. Expenses incurred in preparing and advancing Claims.

7. Other overhead or general expense costs of any kind and the costs of any item not specifically and expressly included in Paragraph 13.01.B.

D. *Contractor's Fee*

1. When the Work as a whole is performed on the basis of cost-plus-a-fee, then:

a. Contractor's fee for the Work set forth in the Contract Documents as of the Effective Date of the Contract will be determined as set forth in the Agreement.

b. for any Work covered by a Change Order, Change Proposal, Claim, set-off, or other adjustment in Contract Price on the basis of Cost of the Work, Contractor's fee will be determined as follows:

1) When the fee for the Work as a whole is a percentage of the Cost of the Work, the fee will automatically adjust as the Cost of the Work changes.

2) When the fee for the Work as a whole is a fixed fee, the fee for any additions or deletions will be determined in accordance with Paragraph 11.07.C.2.

2. When the Work as a whole is performed on the basis of a stipulated sum, or any other basis other than cost-plus-a-fee, then Contractor's fee for any Work covered by a Change

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Order, Change Proposal, Claim, set-off, or other adjustment in Contract Price on the basis of Cost of the Work will be determined in accordance with Paragraph 11.07.C.2.

E. *Documentation and Audit*: Whenever the Cost of the Work for any purpose is to be determined pursuant to this Article 13, Contractor and pertinent Subcontractors will establish and maintain records of the costs in accordance with generally accepted accounting practices. Subject to prior written notice, Owner will be afforded reasonable access, during normal business hours, to all Contractor's accounts, records, books, correspondence, instructions, drawings, receipts, vouchers, memoranda, and similar data relating to the Cost of the Work and Contractor's fee. Contractor shall preserve all such documents for a period of three years after the final payment by Owner. Pertinent Subcontractors will afford such access to Owner, and preserve such documents, to the same extent required of Contractor.

13.02 *Allowances*

A. It is understood that Contractor has included in the Contract Price all allowances so named in the Contract Documents and shall cause the Work so covered to be performed for such sums and by such persons or entities as may be acceptable to Owner and Engineer.

B. *Cash Allowances*: Contractor agrees that:

1. the cash allowances include the cost to Contractor (less any applicable trade discounts) of materials and equipment required by the allowances to be delivered at the Site, and all applicable taxes; and

2. Contractor's costs for unloading and handling on the Site, labor, installation, overhead, profit, and other expenses contemplated for the cash allowances have been included in the Contract Price and not in the allowances, and no demand for additional payment for any of the foregoing will be valid.

C. *Owner's Contingency Allowance*: Contractor agrees that an Owner's contingency allowance, if any, is for the sole use of Owner to cover unanticipated costs.

D. Prior to final payment, an appropriate Change Order will be issued as recommended by Engineer to reflect actual amounts due Contractor for Work covered by allowances, and the Contract Price will be correspondingly adjusted.

13.03 *Unit Price Work*

A. Where the Contract Documents provide that all or part of the Work is to be Unit Price Work, initially the Contract Price will be deemed to include for all Unit Price Work an amount equal to the sum of the unit price for each separately identified item of Unit Price Work times the estimated quantity of each item as indicated in the Agreement.

B. The estimated quantities of items of Unit Price Work are not guaranteed and are solely for the purpose of comparison of Bids and determining an initial Contract Price. Payments to Contractor for Unit Price Work will be based on actual quantities.

C. Each unit price will be deemed to include an amount considered by Contractor to be adequate to cover Contractor's overhead and profit for each separately identified item.

D. Engineer will determine the actual quantities and classifications of Unit Price Work performed by Contractor. Engineer will review with Contractor the Engineer's preliminary determinations on such matters before rendering a written decision thereon (by recommendation of an Application for Payment or otherwise). Engineer's written decision

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thereon will be final and binding (except as modified by Engineer to reflect changed factual conditions or more accurate data) upon Owner and Contractor, and the final adjustment of Contract Price will be set forth in a Change Order, subject to the provisions of the following paragraph.

E. *Adjustments in Unit Price*

1. Contractor or Owner shall be entitled to an adjustment in the unit price with respect to an item of Unit Price Work if:

a. the quantity of the item of Unit Price Work performed by Contractor differs materially and significantly from the estimated quantity of such item indicated in the Agreement; and

b. Contractor's unit costs to perform the item of Unit Price Work have changed materially and significantly as a result of the quantity change.

2. The adjustment in unit price will account for and be coordinated with any related changes in quantities of other items of Work, and in Contractor's costs to perform such other Work, such that the resulting overall change in Contract Price is equitable to Owner and Contractor.

3. Adjusted unit prices will apply to all units of that item.

ARTICLE 14—TESTS AND INSPECTIONS; CORRECTION, REMOVAL, OR ACCEPTANCE OF DEFECTIVE WORK

14.01 *Access to Work*

A. Owner, Engineer, their consultants and other representatives and personnel of Owner, independent testing laboratories, and authorities having jurisdiction have access to the Site and the Work at reasonable times for their observation, inspection, and testing. Contractor shall provide them proper and safe conditions for such access and advise them of Contractor's safety procedures and programs so that they may comply with such procedures and programs as applicable.

14.02 *Tests, Inspections, and Approvals*

A. Contractor shall give Engineer timely notice of readiness of the Work (or specific parts thereof) for all required inspections and tests, and shall cooperate with inspection and testing personnel to facilitate required inspections and tests.

B. Owner shall retain and pay for the services of an independent inspector, testing laboratory, or other qualified individual or entity to perform all inspections and tests expressly required by the Contract Documents to be furnished and paid for by Owner, except that costs incurred in connection with tests or inspections of covered Work will be governed by the provisions of Paragraph 14.05.

C. If Laws or Regulations of any public body having jurisdiction require any Work (or part thereof) specifically to be inspected, tested, or approved by an employee or other representative of such public body, Contractor shall assume full responsibility for arranging and obtaining such inspections, tests, or approvals, pay all costs in connection therewith, and furnish Engineer the required certificates of inspection or approval.

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D. Contractor shall be responsible for arranging, obtaining, and paying for all inspections and tests required:

1. by the Contract Documents, unless the Contract Documents expressly allocate responsibility for a specific inspection or test to Owner;

2. to attain Owner's and Engineer's acceptance of materials or equipment to be incorporated in the Work;

3. by manufacturers of equipment furnished under the Contract Documents;

4. for testing, adjusting, and balancing of mechanical, electrical, and other equipment to be incorporated into the Work; and

5. for acceptance of materials, mix designs, or equipment submitted for approval prior to Contractor's purchase thereof for incorporation in the Work.

Such inspections and tests will be performed by independent inspectors, testing laboratories, or other qualified individuals or entities acceptable to Owner and Engineer.

E. If the Contract Documents require the Work (or part thereof) to be approved by Owner, Engineer, or another designated individual or entity, then Contractor shall assume full responsibility for arranging and obtaining such approvals.

F. If any Work (or the work of others) that is to be inspected, tested, or approved is covered by Contractor without written concurrence of Engineer, Contractor shall, if requested by Engineer, uncover such Work for observation. Such uncovering will be at Contractor's expense unless Contractor had given Engineer timely notice of Contractor's intention to cover the same and Engineer had not acted with reasonable promptness in response to such notice.

14.03 *Defective Work*

A. *Contractor's Obligation*: It is Contractor's obligation to assure that the Work is not defective.

B. *Engineer's Authority*: Engineer has the authority to determine whether Work is defective, and to reject defective Work.

C. *Notice of Defects*: Prompt written notice of all defective Work of which Owner or Engineer has actual knowledge will be given to Contractor.

D. *Correction, or Removal and Replacement*: Promptly after receipt of written notice of defective Work, Contractor shall correct all such defective Work, whether or not fabricated, installed, or completed, or, if Engineer has rejected the defective Work, remove it from the Project and replace it with Work that is not defective.

E. *Preservation of Warranties*: When correcting defective Work, Contractor shall take no action that would void or otherwise impair Owner's special warranty and guarantee, if any, on said Work.

F. *Costs and Damages*: In addition to its correction, removal, and replacement obligations with respect to defective Work, Contractor shall pay all claims, costs, losses, and damages arising out of or relating to defective Work, including but not limited to the cost of the inspection, testing, correction, removal, replacement, or reconstruction of such defective Work, fines levied against Owner by governmental authorities because the Work is defective, and the costs of repair or replacement of work of others resulting from defective Work. Prior to final payment, if Owner and Contractor are unable to agree as to the measure of such claims, costs,

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losses, and damages resulting from defective Work, then Owner may impose a reasonable set-off against payments due under Article 15.

14.04 *Acceptance of Defective Work*

A. If, instead of requiring correction or removal and replacement of defective Work, Owner prefers to accept it, Owner may do so (subject, if such acceptance occurs prior to final payment, to Engineer's confirmation that such acceptance is in general accord with the design intent and applicable engineering principles, and will not endanger public safety). Contractor shall pay all claims, costs, losses, and damages attributable to Owner's evaluation of and determination to accept such defective Work (such costs to be approved by Engineer as to reasonableness), and for the diminished value of the Work to the extent not otherwise paid by Contractor. If any such acceptance occurs prior to final payment, the necessary revisions in the Contract Documents with respect to the Work will be incorporated in a Change Order. If the parties are unable to agree as to the decrease in the Contract Price, reflecting the diminished value of Work so accepted, then Owner may impose a reasonable set-off against payments due under Article 15. If the acceptance of defective Work occurs after final payment, Contractor shall pay an appropriate amount to Owner.

14.05 *Uncovering Work*

A. Engineer has the authority to require additional inspection or testing of the Work, whether or not the Work is fabricated, installed, or completed.

B. If any Work is covered contrary to the written request of Engineer, then Contractor shall, if requested by Engineer, uncover such Work for Engineer's observation, and then replace the covering, all at Contractor's expense.

C. If Engineer considers it necessary or advisable that covered Work be observed by Engineer or inspected or tested by others, then Contractor, at Engineer's request, shall uncover, expose, or otherwise make available for observation, inspection, or testing as Engineer may require, that portion of the Work in question, and provide all necessary labor, material, and equipment.

1. If it is found that the uncovered Work is defective, Contractor shall be responsible for all claims, costs, losses, and damages arising out of or relating to such uncovering, exposure, observation, inspection, and testing, and of satisfactory replacement or reconstruction (including but not limited to all costs of repair or replacement of work of others); and pending Contractor's full discharge of this responsibility the Owner shall be entitled to impose a reasonable set-off against payments due under Article 15.

2. If the uncovered Work is not found to be defective, Contractor shall be allowed an increase in the Contract Price or an extension of the Contract Times, directly attributable to such uncovering, exposure, observation, inspection, testing, replacement, and reconstruction. If the parties are unable to agree as to the amount or extent thereof, then Contractor may submit a Change Proposal within 30 days of the determination that the Work is not defective.

14.06 *Owner May Stop the Work*

A. If the Work is defective, or Contractor fails to supply sufficient skilled workers or suitable materials or equipment, or fails to perform the Work in such a way that the completed Work will conform to the Contract Documents, then Owner may order Contractor to stop the Work,

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or any portion thereof, until the cause for such order has been eliminated; however, this right of Owner to stop the Work will not give rise to any duty on the part of Owner to exercise this right for the benefit of Contractor, any Subcontractor, any Supplier, any other individual or entity, or any surety for, or employee or agent of any of them.

14.07 *Owner May Correct Defective Work*

A. If Contractor fails within a reasonable time after written notice from Engineer to correct defective Work, or to remove and replace defective Work as required by Engineer, then Owner may, after 7 days' written notice to Contractor, correct or remedy any such deficiency.

B. In exercising the rights and remedies under this Paragraph 14.07, Owner shall proceed expeditiously. In connection with such corrective or remedial action, Owner may exclude Contractor from all or part of the Site, take possession of all or part of the Work and suspend Contractor's services related thereto, and incorporate in the Work all materials and equipment stored at the Site or for which Owner has paid Contractor but which are stored elsewhere. Contractor shall allow Owner, Owner's representatives, agents and employees, Owner's other contractors, and Engineer and Engineer's consultants access to the Site to enable Owner to exercise the rights and remedies under this paragraph.

C. All claims, costs, losses, and damages incurred or sustained by Owner in exercising the rights and remedies under this Paragraph 14.07 will be charged against Contractor as set-offs against payments due under Article 15. Such claims, costs, losses and damages will include but not be limited to all costs of repair, or replacement of work of others destroyed or damaged by correction, removal, or replacement of Contractor's defective Work.

D. Contractor shall not be allowed an extension of the Contract Times because of any delay in the performance of the Work attributable to the exercise by Owner of Owner's rights and remedies under this Paragraph 14.07.

ARTICLE 15—PAYMENTS TO CONTRACTOR; SET-OFFS; COMPLETION; CORRECTION PERIOD

15.01 *Progress Payments*

A. *Basis for Progress Payments*: The Schedule of Values established as provided in Article 2 will serve as the basis for progress payments and will be incorporated into a form of Application for Payment acceptable to Engineer. Progress payments for Unit Price Work will be based on the number of units completed during the pay period, as determined under the provisions of Paragraph 13.03. Progress payments for cost-based Work will be based on Cost of the Work completed by Contractor during the pay period.

B. *Applications for Payments*

1. At least 20 days before the date established in the Agreement for each progress payment (but not more often than once a month), Contractor shall submit to Engineer for review an Application for Payment filled out and signed by Contractor covering the Work completed as of the date of the Application and accompanied by such supporting documentation as is required by the Contract Documents.

2. If payment is requested on the basis of materials and equipment not incorporated in the Work but delivered and suitably stored at the Site or at another location agreed to in writing, the Application for Payment must also be accompanied by: (a) a bill of sale, invoice, copies of subcontract or purchase order payments, or other documentation

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establishing full payment by Contractor for the materials and equipment; (b) at Owner's request, documentation warranting that Owner has received the materials and equipment free and clear of all Liens; and (c) evidence that the materials and equipment are covered by appropriate property insurance, a warehouse bond, or other arrangements to protect Owner's interest therein, all of which must be satisfactory to Owner.

3. Beginning with the second Application for Payment, each Application must include an affidavit of Contractor stating that all previous progress payments received by Contractor have been applied to discharge Contractor's legitimate obligations associated with prior Applications for Payment.

4. The amount of retainage with respect to progress payments will be as stipulated in the Agreement.

C. *Review of Applications*

1. Engineer will, within 10 days after receipt of each Application for Payment, including each resubmittal, either indicate in writing a recommendation of payment and present the Application to Owner, or return the Application to Contractor indicating in writing Engineer's reasons for refusing to recommend payment. In the latter case, Contractor may make the necessary corrections and resubmit the Application.

2. Engineer's recommendation of any payment requested in an Application for Payment will constitute a representation by Engineer to Owner, based on Engineer's observations of the executed Work as an experienced and qualified design professional, and on Engineer's review of the Application for Payment and the accompanying data and schedules, that to the best of Engineer's knowledge, information and belief:

   a. the Work has progressed to the point indicated;

   b. the quality of the Work is generally in accordance with the Contract Documents (subject to an evaluation of the Work as a functioning whole prior to or upon Substantial Completion, the results of any subsequent tests called for in the Contract Documents, a final determination of quantities and classifications for Unit Price Work under Paragraph 13.03, and any other qualifications stated in the recommendation); and

   c. the conditions precedent to Contractor's being entitled to such payment appear to have been fulfilled in so far as it is Engineer's responsibility to observe the Work.

3. By recommending any such payment Engineer will not thereby be deemed to have represented that:

   a. inspections made to check the quality or the quantity of the Work as it has been performed have been exhaustive, extended to every aspect of the Work in progress, or involved detailed inspections of the Work beyond the responsibilities specifically assigned to Engineer in the Contract; or

   b. there may not be other matters or issues between the parties that might entitle Contractor to be paid additionally by Owner or entitle Owner to withhold payment to Contractor.

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4. Neither Engineer's review of Contractor's Work for the purposes of recommending payments nor Engineer's recommendation of any payment, including final payment, will impose responsibility on Engineer:

    a. to supervise, direct, or control the Work;

    b. for the means, methods, techniques, sequences, or procedures of construction, or the safety precautions and programs incident thereto;

    c. for Contractor's failure to comply with Laws and Regulations applicable to Contractor's performance of the Work;

    d. to make any examination to ascertain how or for what purposes Contractor has used the money paid by Owner; or

    e. to determine that title to any of the Work, materials, or equipment has passed to Owner free and clear of any Liens.

5. Engineer may refuse to recommend the whole or any part of any payment if, in Engineer's opinion, it would be incorrect to make the representations to Owner stated in Paragraph 15.01.C.2.

6. Engineer will recommend reductions in payment (set-offs) necessary in Engineer's opinion to protect Owner from loss because:

    a. the Work is defective, requiring correction or replacement;

    b. the Contract Price has been reduced by Change Orders;

    c. Owner has been required to correct defective Work in accordance with Paragraph 14.07, or has accepted defective Work pursuant to Paragraph 14.04;

    d. Owner has been required to remove or remediate a Hazardous Environmental Condition for which Contractor is responsible; or

    e. Engineer has actual knowledge of the occurrence of any of the events that would constitute a default by Contractor and therefore justify termination for cause under the Contract Documents.

D. *Payment Becomes Due*

1. Ten days after presentation of the Application for Payment to Owner with Engineer's recommendation, the amount recommended (subject to any Owner set-offs) will become due, and when due will be paid by Owner to Contractor.

E. *Reductions in Payment by Owner*

1. In addition to any reductions in payment (set-offs) recommended by Engineer, Owner is entitled to impose a set-off against payment based on any of the following:

    a. Claims have been made against Owner based on Contractor's conduct in the performance or furnishing of the Work, or Owner has incurred costs, losses, or damages resulting from Contractor's conduct in the performance or furnishing of the Work, including but not limited to claims, costs, losses, or damages from workplace injuries, adjacent property damage, non-compliance with Laws and Regulations, and patent infringement;

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b. Contractor has failed to take reasonable and customary measures to avoid damage, delay, disruption, and interference with other work at or adjacent to the Site;

c. Contractor has failed to provide and maintain required bonds or insurance;

d. Owner has been required to remove or remediate a Hazardous Environmental Condition for which Contractor is responsible;

e. Owner has incurred extra charges or engineering costs related to submittal reviews, evaluations of proposed substitutes, tests and inspections, or return visits to manufacturing or assembly facilities;

f. The Work is defective, requiring correction or replacement;

g. Owner has been required to correct defective Work in accordance with Paragraph 14.07, or has accepted defective Work pursuant to Paragraph 14.04;

h. The Contract Price has been reduced by Change Orders;

i. An event has occurred that would constitute a default by Contractor and therefore justify a termination for cause;

j. Liquidated or other damages have accrued as a result of Contractor's failure to achieve Milestones, Substantial Completion, or final completion of the Work;

k. Liens have been filed in connection with the Work, except where Contractor has delivered a specific bond satisfactory to Owner to secure the satisfaction and discharge of such Liens; or

l. Other items entitle Owner to a set-off against the amount recommended.

2. If Owner imposes any set-off against payment, whether based on its own knowledge or on the written recommendations of Engineer, Owner will give Contractor immediate written notice (with a copy to Engineer) stating the reasons for such action and the specific amount of the reduction, and promptly pay Contractor any amount remaining after deduction of the amount so withheld. Owner shall promptly pay Contractor the amount so withheld, or any adjustment thereto agreed to by Owner and Contractor, if Contractor remedies the reasons for such action. The reduction imposed will be binding on Contractor unless it duly submits a Change Proposal contesting the reduction.

3. Upon a subsequent determination that Owner's refusal of payment was not justified, the amount wrongfully withheld will be treated as an amount due as determined by Paragraph 15.01.D.1 and subject to interest as provided in the Agreement.

15.02 *Contractor's Warranty of Title*

A. Contractor warrants and guarantees that title to all Work, materials, and equipment furnished under the Contract will pass to Owner free and clear of (1) all Liens and other title defects, and (2) all patent, licensing, copyright, or royalty obligations, no later than 7 days after the time of payment by Owner.

15.03 *Substantial Completion*

A. When Contractor considers the entire Work ready for its intended use Contractor shall notify Owner and Engineer in writing that the entire Work is substantially complete and request that Engineer issue a certificate of Substantial Completion. Contractor shall at the same time

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submit to Owner and Engineer an initial draft of punch list items to be completed or corrected before final payment.

B. Promptly after Contractor's notification, Owner, Contractor, and Engineer shall make an inspection of the Work to determine the status of completion. If Engineer does not consider the Work substantially complete, Engineer will notify Contractor in writing giving the reasons therefor.

C. If Engineer considers the Work substantially complete, Engineer will deliver to Owner a preliminary certificate of Substantial Completion which will fix the date of Substantial Completion. Engineer shall attach to the certificate a punch list of items to be completed or corrected before final payment. Owner shall have 7 days after receipt of the preliminary certificate during which to make written objection to Engineer as to any provisions of the certificate or attached punch list. If, after considering the objections to the provisions of the preliminary certificate, Engineer concludes that the Work is not substantially complete, Engineer will, within 14 days after submission of the preliminary certificate to Owner, notify Contractor in writing that the Work is not substantially complete, stating the reasons therefor. If Owner does not object to the provisions of the certificate, or if despite consideration of Owner's objections Engineer concludes that the Work is substantially complete, then Engineer will, within said 14 days, execute and deliver to Owner and Contractor a final certificate of Substantial Completion (with a revised punch list of items to be completed or corrected) reflecting such changes from the preliminary certificate as Engineer believes justified after consideration of any objections from Owner.

D. At the time of receipt of the preliminary certificate of Substantial Completion, Owner and Contractor will confer regarding Owner's use or occupancy of the Work following Substantial Completion, review the builder's risk insurance policy with respect to the end of the builder's risk coverage, and confirm the transition to coverage of the Work under a permanent property insurance policy held by Owner. Unless Owner and Contractor agree otherwise in writing, Owner shall bear responsibility for security, operation, protection of the Work, property insurance, maintenance, heat, and utilities upon Owner's use or occupancy of the Work.

E. After Substantial Completion the Contractor shall promptly begin work on the punch list of items to be completed or corrected prior to final payment. In appropriate cases Contractor may submit monthly Applications for Payment for completed punch list items, following the progress payment procedures set forth above.

F. Owner shall have the right to exclude Contractor from the Site after the date of Substantial Completion subject to allowing Contractor reasonable access to remove its property and complete or correct items on the punch list.

15.04 *Partial Use or Occupancy*

A. Prior to Substantial Completion of all the Work, Owner may use or occupy any substantially completed part of the Work which has specifically been identified in the Contract Documents, or which Owner, Engineer, and Contractor agree constitutes a separately functioning and usable part of the Work that can be used by Owner for its intended purpose without

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significant interference with Contractor's performance of the remainder of the Work, subject to the following conditions:

1. At any time, Owner may request in writing that Contractor permit Owner to use or occupy any such part of the Work that Owner believes to be substantially complete. If and when Contractor agrees that such part of the Work is substantially complete, Contractor, Owner, and Engineer will follow the procedures of Paragraph 15.03.A through 15.03.E for that part of the Work.

2. At any time, Contractor may notify Owner and Engineer in writing that Contractor considers any such part of the Work substantially complete and request Engineer to issue a certificate of Substantial Completion for that part of the Work.

3. Within a reasonable time after either such request, Owner, Contractor, and Engineer shall make an inspection of that part of the Work to determine its status of completion. If Engineer does not consider that part of the Work to be substantially complete, Engineer will notify Owner and Contractor in writing giving the reasons therefor. If Engineer considers that part of the Work to be substantially complete, the provisions of Paragraph 15.03 will apply with respect to certification of Substantial Completion of that part of the Work and the division of responsibility in respect thereof and access thereto.

4. No use or occupancy or separate operation of part of the Work may occur prior to compliance with the requirements of Paragraph 6.04 regarding builder's risk or other property insurance.

15.05 *Final Inspection*

A. Upon written notice from Contractor that the entire Work or an agreed portion thereof is complete, Engineer will promptly make a final inspection with Owner and Contractor and will notify Contractor in writing of all particulars in which this inspection reveals that the Work, or agreed portion thereof, is incomplete or defective. Contractor shall immediately take such measures as are necessary to complete such Work or remedy such deficiencies.

15.06 *Final Payment*

A. *Application for Payment*

1. After Contractor has, in the opinion of Engineer, satisfactorily completed all corrections identified during the final inspection and has delivered, in accordance with the Contract Documents, all maintenance and operating instructions, schedules, guarantees, bonds, certificates or other evidence of insurance, certificates of inspection, annotated record documents (as provided in Paragraph 7.12), and other documents, Contractor may make application for final payment.

2. The final Application for Payment must be accompanied (except as previously delivered) by:

   a. all documentation called for in the Contract Documents;

   b. consent of the surety, if any, to final payment;

   c. satisfactory evidence that all title issues have been resolved such that title to all Work, materials, and equipment has passed to Owner free and clear of any Liens or other title defects, or will so pass upon final payment.

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d. a list of all duly pending Change Proposals and Claims; and

e. complete and legally effective releases or waivers (satisfactory to Owner) of all Lien rights arising out of the Work, and of Liens filed in connection with the Work.

3. In lieu of the releases or waivers of Liens specified in Paragraph 15.06.A.2 and as approved by Owner, Contractor may furnish receipts or releases in full and an affidavit of Contractor that: (a) the releases and receipts include all labor, services, material, and equipment for which a Lien could be filed; and (b) all payrolls, material and equipment bills, and other indebtedness connected with the Work for which Owner might in any way be responsible, or which might in any way result in liens or other burdens on Owner's property, have been paid or otherwise satisfied. If any Subcontractor or Supplier fails to furnish such a release or receipt in full, Contractor may furnish a bond or other collateral satisfactory to Owner to indemnify Owner against any Lien, or Owner at its option may issue joint checks payable to Contractor and specified Subcontractors and Suppliers.

B. *Engineer's Review of Final Application and Recommendation of Payment*: If, on the basis of Engineer's observation of the Work during construction and final inspection, and Engineer's review of the final Application for Payment and accompanying documentation as required by the Contract Documents, Engineer is satisfied that the Work has been completed and Contractor's other obligations under the Contract have been fulfilled, Engineer will, within 10 days after receipt of the final Application for Payment, indicate in writing Engineer's recommendation of final payment and present the final Application for Payment to Owner for payment. Such recommendation will account for any set-offs against payment that are necessary in Engineer's opinion to protect Owner from loss for the reasons stated above with respect to progress payments. Otherwise, Engineer will return the Application for Payment to Contractor, indicating in writing the reasons for refusing to recommend final payment, in which case Contractor shall make the necessary corrections and resubmit the Application for Payment.

C. *Notice of Acceptability*: In support of its recommendation of payment of the final Application for Payment, Engineer will also give written notice to Owner and Contractor that the Work is acceptable, subject to stated limitations in the notice and to the provisions of Paragraph 15.07.

D. *Completion of Work*: The Work is complete (subject to surviving obligations) when it is ready for final payment as established by the Engineer's written recommendation of final payment and issuance of notice of the acceptability of the Work.

E. *Final Payment Becomes Due*: Upon receipt from Engineer of the final Application for Payment and accompanying documentation, Owner shall set off against the amount recommended by Engineer for final payment any further sum to which Owner is entitled, including but not limited to set-offs for liquidated damages and set-offs allowed under the provisions of this Contract with respect to progress payments. Owner shall pay the resulting balance due to Contractor within 30 days of Owner's receipt of the final Application for Payment from Engineer.

15.07 *Waiver of Claims*

A. By making final payment, Owner waives its claim or right to liquidated damages or other damages for late completion by Contractor, except as set forth in an outstanding Claim,

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appeal under the provisions of Article 17, set-off, or express reservation of rights by Owner. Owner reserves all other claims or rights after final payment.

B. The acceptance of final payment by Contractor will constitute a waiver by Contractor of all claims and rights against Owner other than those pending matters that have been duly submitted as a Claim, or appealed under the provisions of Article 17.

15.08 *Correction Period*

A. If within one year after the date of Substantial Completion (or such longer period of time as may be prescribed by the Supplementary Conditions or the terms of any applicable special guarantee required by the Contract Documents), Owner gives Contractor written notice that any Work has been found to be defective, or that Contractor's repair of any damages to the Site or adjacent areas has been found to be defective, then after receipt of such notice of defect Contractor shall promptly, without cost to Owner and in accordance with Owner's written instructions:

1. correct the defective repairs to the Site or such adjacent areas;
2. correct such defective Work;
3. remove the defective Work from the Project and replace it with Work that is not defective, if the defective Work has been rejected by Owner, and
4. satisfactorily correct or repair or remove and replace any damage to other Work, to the work of others, or to other land or areas resulting from the corrective measures.

B. Owner shall give any such notice of defect within 60 days of the discovery that such Work or repairs is defective. If such notice is given within such 60 days but after the end of the correction period, the notice will be deemed a notice of defective Work under Paragraph 7.17.B.

C. If, after receipt of a notice of defect within 60 days and within the correction period, Contractor does not promptly comply with the terms of Owner's written instructions, or in an emergency where delay would cause serious risk of loss or damage, Owner may have the defective Work corrected or repaired or may have the rejected Work removed and replaced. Contractor shall pay all costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to such correction or repair or such removal and replacement (including but not limited to all costs of repair or replacement of work of others). Contractor's failure to pay such costs, losses, and damages within 10 days of invoice from Owner will be deemed the start of an event giving rise to a Claim under Paragraph 12.01.B, such that any related Claim must be brought within 30 days of the failure to pay.

D. In special circumstances where a particular item of equipment is placed in continuous service before Substantial Completion of all the Work, the correction period for that item may start to run from an earlier date if so provided in the Specifications.

E. Where defective Work (and damage to other Work resulting therefrom) has been corrected or removed and replaced under this paragraph, the correction period hereunder with respect to such Work will be extended for an additional period of one year after such correction or removal and replacement has been satisfactorily completed.

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F. Contractor's obligations under this paragraph are in addition to all other obligations and warranties. The provisions of this paragraph are not to be construed as a substitute for, or a waiver of, the provisions of any applicable statute of limitation or repose.

ARTICLE 16—SUSPENSION OF WORK AND TERMINATION

16.01 *Owner May Suspend Work*

A. At any time and without cause, Owner may suspend the Work or any portion thereof for a period of not more than 90 consecutive days by written notice to Contractor and Engineer. Such notice will fix the date on which Work will be resumed. Contractor shall resume the Work on the date so fixed. Contractor shall be entitled to an adjustment in the Contract Price or an extension of the Contract Times directly attributable to any such suspension. Any Change Proposal seeking such adjustments must be submitted no later than 30 days after the date fixed for resumption of Work.

16.02 *Owner May Terminate for Cause*

A. The occurrence of any one or more of the following events will constitute a default by Contractor and justify termination for cause:

1. Contractor's persistent failure to perform the Work in accordance with the Contract Documents (including, but not limited to, failure to supply sufficient skilled workers or suitable materials or equipment, or failure to adhere to the Progress Schedule);

2. Failure of Contractor to perform or otherwise to comply with a material term of the Contract Documents;

3. Contractor's disregard of Laws or Regulations of any public body having jurisdiction; or

4. Contractor's repeated disregard of the authority of Owner or Engineer.

B. If one or more of the events identified in Paragraph 16.02.A occurs, then after giving Contractor (and any surety) 10 days' written notice that Owner is considering a declaration that Contractor is in default and termination of the Contract, Owner may proceed to:

1. declare Contractor to be in default, and give Contractor (and any surety) written notice that the Contract is terminated; and

2. enforce the rights available to Owner under any applicable performance bond.

C. Subject to the terms and operation of any applicable performance bond, if Owner has terminated the Contract for cause, Owner may exclude Contractor from the Site, take possession of the Work, incorporate in the Work all materials and equipment stored at the Site or for which Owner has paid Contractor but which are stored elsewhere, and complete the Work as Owner may deem expedient.

D. Owner may not proceed with termination of the Contract under Paragraph 16.02.B if Contractor within 7 days of receipt of notice of intent to terminate begins to correct its failure to perform and proceeds diligently to cure such failure.

E. If Owner proceeds as provided in Paragraph 16.02.B, Contractor shall not be entitled to receive any further payment until the Work is completed. If the unpaid balance of the Contract Price exceeds the cost to complete the Work, including all related claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects,

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attorneys, and other professionals) sustained by Owner, such excess will be paid to Contractor. If the cost to complete the Work including such related claims, costs, losses, and damages exceeds such unpaid balance, Contractor shall pay the difference to Owner. Such claims, costs, losses, and damages incurred by Owner will be reviewed by Engineer as to their reasonableness and, when so approved by Engineer, incorporated in a Change Order. When exercising any rights or remedies under this paragraph, Owner shall not be required to obtain the lowest price for the Work performed.

F. Where Contractor's services have been so terminated by Owner, the termination will not affect any rights or remedies of Owner against Contractor then existing or which may thereafter accrue, or any rights or remedies of Owner against Contractor or any surety under any payment bond or performance bond. Any retention or payment of money due Contractor by Owner will not release Contractor from liability.

G. If and to the extent that Contractor has provided a performance bond under the provisions of Paragraph 6.01.A, the provisions of that bond will govern over any inconsistent provisions of Paragraphs 16.02.B and 16.02.D.

16.03 *Owner May Terminate for Convenience*

A. Upon 7 days' written notice to Contractor and Engineer, Owner may, without cause and without prejudice to any other right or remedy of Owner, terminate the Contract. In such case, Contractor shall be paid for (without duplication of any items):

1. completed and acceptable Work executed in accordance with the Contract Documents prior to the effective date of termination, including fair and reasonable sums for overhead and profit on such Work;

2. expenses sustained prior to the effective date of termination in performing services and furnishing labor, materials, or equipment as required by the Contract Documents in connection with uncompleted Work, plus fair and reasonable sums for overhead and profit on such expenses; and

3. other reasonable expenses directly attributable to termination, including costs incurred to prepare a termination for convenience cost proposal.

B. Contractor shall not be paid for any loss of anticipated profits or revenue, post-termination overhead costs, or other economic loss arising out of or resulting from such termination.

16.04 *Contractor May Stop Work or Terminate*

A. If, through no act or fault of Contractor, (1) the Work is suspended for more than 90 consecutive days by Owner or under an order of court or other public authority, or (2) Engineer fails to act on any Application for Payment within 30 days after it is submitted, or (3) Owner fails for 30 days to pay Contractor any sum finally determined to be due, then Contractor may, upon 7 days' written notice to Owner and Engineer, and provided Owner or Engineer do not remedy such suspension or failure within that time, terminate the contract and recover from Owner payment on the same terms as provided in Paragraph 16.03.

B. In lieu of terminating the Contract and without prejudice to any other right or remedy, if Engineer has failed to act on an Application for Payment within 30 days after it is submitted, or Owner has failed for 30 days to pay Contractor any sum finally determined to be due, Contractor may, 7 days after written notice to Owner and Engineer, stop the Work until payment is made of all such amounts due Contractor, including interest thereon. The

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provisions of this paragraph are not intended to preclude Contractor from submitting a Change Proposal for an adjustment in Contract Price or Contract Times or otherwise for expenses or damage directly attributable to Contractor's stopping the Work as permitted by this paragraph.

ARTICLE 17—FINAL RESOLUTION OF DISPUTES

17.01 *Methods and Procedures*

A. *Disputes Subject to Final Resolution*: The following disputed matters are subject to final resolution under the provisions of this article:

1. A timely appeal of an approval in part and denial in part of a Claim, or of a denial in full, pursuant to Article 12; and

2. Disputes between Owner and Contractor concerning the Work, or obligations under the Contract Documents, that arise after final payment has been made.

B. *Final Resolution of Disputes*: For any dispute subject to resolution under this article, Owner or Contractor may:

1. elect in writing to invoke the dispute resolution process provided for in the Supplementary Conditions;

2. agree with the other party to submit the dispute to another dispute resolution process; or

3. if no dispute resolution process is provided for in the Supplementary Conditions or mutually agreed to, give written notice to the other party of the intent to submit the dispute to a court of competent jurisdiction.

ARTICLE 18—MISCELLANEOUS

18.01 *Giving Notice*

A. Whenever any provision of the Contract requires the giving of written notice to Owner, Engineer, or Contractor, it will be deemed to have been validly given only if delivered:

1. in person, by a commercial courier service or otherwise, to the recipient's place of business;

2. by registered or certified mail, postage prepaid, to the recipient's place of business; or

3. by e-mail to the recipient, with the words "Formal Notice" or similar in the e-mail's subject line.

18.02 *Computation of Times*

A. When any period of time is referred to in the Contract by days, it will be computed to exclude the first and include the last day of such period. If the last day of any such period falls on a Saturday or Sunday or on a day made a legal holiday by the law of the applicable jurisdiction, such day will be omitted from the computation.

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18.03 *Cumulative Remedies*

A. The duties and obligations imposed by these General Conditions and the rights and remedies available hereunder to the parties hereto are in addition to, and are not to be construed in any way as a limitation of, any rights and remedies available to any or all of them which are otherwise imposed or available by Laws or Regulations, by special warranty or guarantee, or by other provisions of the Contract. The provisions of this paragraph will be as effective as if repeated specifically in the Contract Documents in connection with each particular duty, obligation, right, and remedy to which they apply.

18.04 *Limitation of Damages*

A. With respect to any and all Change Proposals, Claims, disputes subject to final resolution, and other matters at issue, neither Owner nor Engineer, nor any of their officers, directors, members, partners, employees, agents, consultants, or subcontractors, shall be liable to Contractor for any claims, costs, losses, or damages sustained by Contractor on or in connection with any other project or anticipated project.

18.05 *No Waiver*

A. A party's non-enforcement of any provision will not constitute a waiver of that provision, nor will it affect the enforceability of that provision or of the remainder of this Contract.

18.06 *Survival of Obligations*

A. All representations, indemnifications, warranties, and guarantees made in, required by, or given in accordance with the Contract, as well as all continuing obligations indicated in the Contract, will survive final payment, completion, and acceptance of the Work or termination of the Contract or of the services of Contractor.

18.07 *Controlling Law*

A. This Contract is to be governed by the law of the state in which the Project is located.

18.08 *Assignment of Contract*

A. Unless expressly agreed to elsewhere in the Contract, no assignment by a party to this Contract of any rights under or interests in the Contract will be binding on the other party without the written consent of the party sought to be bound; and, specifically but without limitation, money that may become due and money that is due may not be assigned without such consent (except to the extent that the effect of this restriction may be limited by law), and unless specifically stated to the contrary in any written consent to an assignment, no assignment will release or discharge the assignor from any duty or responsibility under the Contract.

18.09 *Successors and Assigns*

A. Owner and Contractor each binds itself, its successors, assigns, and legal representatives to the other party hereto, its successors, assigns, and legal representatives in respect to all covenants, agreements, and obligations contained in the Contract Documents.

18.10 *Headings*

A. Article and paragraph headings are inserted for convenience only and do not constitute parts of these General Conditions.

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SUPPLEMENTARY CONDITIONS OF THE CONSTRUCTION CONTRACT

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SUPPLEMENTARY CONDITIONS OF THE CONSTRUCTION CONTRACT

These Supplementary Conditions amend or supplement EJCDC® C-700, Standard General Conditions of the Construction Contract (2018). The General Conditions remain in full force and effect except as amended.

The terms used in these Supplementary Conditions have the meanings stated in the General Conditions. Additional terms used in these Supplementary Conditions have the meanings stated below, which are applicable to both the singular and plural thereof.

The address system used in these Supplementary Conditions is the same as the address system used in the General Conditions, with the prefix "SC" added—for example, “Paragraph SC-4.05.”

1. DEFINITIONS AND TERMINOLOGY

No suggested Supplementary Conditions in this Article.

2. PRELIMINARY MATTERS

2.02 *Copies of Documents*

SC-2.02 Amend the first sentence of Paragraph 2.02.A. to read as follows:

Owner shall furnish to Contractor **up to three** printed copies of the Contract Documents (including one fully signed counterpart of the Agreement), and one copy in electronic portable document format (PDF). Additional copies maybe requested to be purchased at cost.

3. CONTRACT DOCUMENTS: INTENT, REQUIREMENTS, REUSE

3.01 No suggested Supplementary Conditions in this Article.

4. COMMENCEMENT AND PROGRESS OF THE WORK

4.05 *Delays in Contractor’s Progress*

SC-4.05 Amend Paragraph 4.05.C by adding the following subparagraphs:

5. *Weather-Related Delays*

a. If “abnormal weather conditions” as set forth in Paragraph 4.05.C.2 of the General Conditions are the basis for a request for an equitable adjustment in the Contract Times, such request must be documented by data substantiating each of the following: 1) that weather conditions were abnormal for the period of time in which the delay occurred, 2) that such weather conditions could not have been reasonably anticipated, and 3) that such weather conditions had an adverse effect on the Work as scheduled.

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5. SITE, SUBSURFACE AND PHYSICAL CONDITIONS, HAZARDOUS ENVIRONMENTAL CONDITIONS

5.03 *Subsurface and Physical Conditions*

SC-5.03 Add the following new paragraphs immediately after Paragraph 5.03.D:

E. The following table lists the reports of explorations and tests of subsurface conditions at or adjacent to the Site that contain Technical Data, and specifically identifies the Technical Data in the report upon which Contractor may rely:

Report Title	Date of Report	Technical Data
Refer to Construction Drawings	N/A	N/A

F. The following table lists the drawings of existing physical conditions at or adjacent to the Site, including those drawings depicting existing surface or subsurface structures at or adjacent to the Site (except Underground Facilities), that contain Technical Data, and specifically identifies the Technical Data upon which Contractor may rely:

Drawings Title	Date of Drawings	Technical Data
Refer to Construction Drawings	N/A	

5.06 *Hazardous Environmental Conditions*

SC-5.06 Add the following new paragraphs immediately after Paragraph 5.06.A.3:

4. The following table lists the reports known to Owner relating to Hazardous Environmental Conditions at or adjacent to the Site, and the Technical Data (if any) upon which Contractor may rely: **[If there are no such reports, so indicate in the table]**

Report Title	Date of Report	Technical Data
Refer to Construction Drawings	N/A	N/A

5. The following table lists the drawings known to Owner relating to Hazardous Environmental Conditions at or adjacent to the Site, and Technical Data (if any) contained in such Drawings upon which Contractor may rely: **[If there are no such drawings, so indicate in the table]**

Drawings Title	Date of Drawings	Technical Data
Refer to Construction Drawings	N/A	N/A

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6. BONDS AND INSURANCE

6.01 *Performance, Payment, and Other Bonds*

SC-6.01 Add the following paragraphs immediately after Paragraph 6.01.A:

1. *Required Performance Bond Form:* The performance bond that Contractor furnishes will be in the form of EJCDC® C-610, Performance Bond (2010, 2013, or 2018 edition).

2. *Required Payment Bond Form:* The payment bond that Contractor furnishes will be in the form of EJCDC® C-615, Payment Bond (2010, 2013, or 2018 edition).

6.03 *Contractor's Insurance*

SC-6.03 Supplement Paragraph 6.03 with the following provisions after Paragraph 6.03.C:

D. *Other Additional Insureds:* As a supplement to the provisions of Paragraph 6.03.C of the General Conditions, the commercial general liability, automobile liability, umbrella or excess, pollution liability, and unmanned aerial vehicle liability policies must include as additional insureds (in addition to Owner and Engineer) the following: **None**

E. *Workers' Compensation and Employer's Liability:* Contractor shall purchase and maintain workers' compensation and employer's liability insurance, including, as applicable, United States Longshoreman and Harbor Workers' Compensation Act, Jones Act, stop-gap employer's liability coverage for monopolistic states, and foreign voluntary workers' compensation (from available sources, notwithstanding the jurisdictional requirement of Paragraph 6.02.B of the General Conditions).

Workers' Compensation and Related Policies	Policy limits of not less than:
Workers' Compensation	
State	Statutory
Applicable Federal (e.g., Longshoreman's)	Statutory
Foreign voluntary workers' compensation (employer's responsibility coverage), if applicable	Statutory
Employer's Liability	
Each accident	$500,000.00
Each employee	$500,000.00
Policy limit	$500,000.00

F. *Commercial General Liability—Claims Covered:* Contractor shall purchase and maintain commercial general liability insurance, covering all operations by or on behalf of Contractor, on an occurrence basis, against claims for:

1. damages because of bodily injury, sickness or disease, or death of any person other than Contractor's employees,

2. damages insured by reasonably available personal injury liability coverage, and

3. damages because of injury to or destruction of tangible property wherever located, including loss of use resulting therefrom.

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G. *Commercial General Liability—Form and Content:* Contractor's commercial liability policy must be written on a 1996 (or later) Insurance Services Organization, Inc. (ISO) commercial general liability form (occurrence form) and include the following coverages and endorsements:

1. Products and completed operations coverage.
    a. Such insurance must be maintained for three years after final payment.
    b. Contractor shall furnish Owner and each other additional insured (as identified in the Supplementary Conditions or elsewhere in the Contract) evidence of continuation of such insurance at final payment and three years thereafter.
2. Blanket contractual liability coverage, including but not limited to coverage of Contractor's contractual indemnity obligations in Paragraph 7.18.
3. Severability of interests and no insured-versus-insured or cross-liability exclusions.
4. Underground, explosion, and collapse coverage.
5. Personal injury coverage.
6. Additional insured endorsements that include both ongoing operations and products and completed operations coverage through ISO Endorsements CG 20 10 10 01 and CG 20 37 10 01 (together). If Contractor demonstrates to Owner that the specified ISO endorsements are not commercially available, then Contractor may satisfy this requirement by providing equivalent endorsements.
7. For design professional additional insureds, ISO Endorsement CG 20 32 07 04 "Additional Insured—Engineers, Architects or Surveyors Not Engaged by the Named Insured" or its equivalent.

H. *Commercial General Liability—Excluded Content:* The commercial general liability insurance policy, including its coverages, endorsements, and incorporated provisions, must not include any of the following:

1. Any modification of the standard definition of "insured contract" (except to delete the railroad protective liability exclusion if Contractor is required to indemnify a railroad or others with respect to Work within 50 feet of railroad property).
2. Any exclusion for water intrusion or water damage.
3. Any provisions resulting in the erosion of insurance limits by defense costs other than those already incorporated in ISO form CG 00 01.
4. Any exclusion of coverage relating to earth subsidence or movement.
5. Any exclusion for the insured's vicarious liability, strict liability, or statutory liability (other than worker's compensation).
6. Any limitation or exclusion based on the nature of Contractor's work.
7. Any professional liability exclusion broader in effect than the most recent edition of ISO form CG 22 79.

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I. *Commercial General Liability—Minimum Policy Limits*

Commercial General Liability	Policy limits of not less than:
General Aggregate	$2,000,000.00
Products—Completed Operations Aggregate	$1,000,000.00
Personal and Advertising Injury	$500,000.00
Bodily Injury and Property Damage—Each Occurrence	$1,000,000.00

J. *Automobile Liability:* Contractor shall purchase and maintain automobile liability insurance for damages because of bodily injury or death of any person or property damage arising out of the ownership, maintenance, or use of any motor vehicle. The automobile liability policy must be written on an occurrence basis.

Automobile Liability	Policy limits of not less than:
Bodily Injury	
Each Person	$1,000,000.00
Each Accident	$1,000,000.00
Property Damage	
Each Accident	$1,000,000.00

K. *Umbrella or Excess Liability:* Contractor shall purchase and maintain umbrella or excess liability insurance written over the underlying employer's liability, commercial general liability, and automobile liability insurance described in the Paragraphs above. The coverage afforded must be at least as broad as that of each and every one of the underlying policies.

Excess or Umbrella Liability	Policy limits of not less than:
Each Occurrence	$1,000,000.00
General Aggregate	$2,000,000.00

L. *Using Umbrella or Excess Liability Insurance to Meet CGL and Other Policy Limit Requirements:* Contractor may meet the policy limits specified for employer's liability, commercial general liability, and automobile liability through the primary policies alone, or through combinations of the primary insurance policy's policy limits and partial attribution of the policy limits of an umbrella or excess liability policy that is at least as broad in coverage as that of the underlying policy, as specified herein. If such umbrella or excess liability policy was required under this Contract, at a specified minimum policy limit, such umbrella or excess policy must retain a minimum limit of $**1,000,000.00** after accounting for partial attribution of its limits to underlying policies, as allowed above.

M. *Contractor's Pollution Liability Insurance:* Contractor shall purchase and maintain a policy covering third-party injury and property damage, including cleanup costs, as a result of pollution conditions arising from Contractor's operations and completed operations. This insurance must be maintained for no less than three years after final completion.

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Contractor's Pollution Liability	Policy limits of not less than:
Each Occurrence/Claim	N/A
General Aggregate	N/A

N. *Contractor's Professional Liability Insurance:* If Contractor will provide or furnish professional services under this *Contract*, through a delegation of professional design services or otherwise, then Contractor shall be responsible for purchasing and maintaining applicable professional liability insurance. This insurance must cover negligent acts, errors, or omissions in the performance of professional design or related services by the insured or others for whom the insured is legally liable. The insurance must be maintained throughout the duration of the Contract and for a minimum of two years after Substantial Completion. The retroactive date on the policy must pre-date the commencement of furnishing services on the Project.

Contractor's Professional Liability	Policy limits of not less than:
Each Claim	$1,000,000.00
Annual Aggregate	$2,000,000.00

O. *Railroad Protective Liability Insurance:* Prior to commencing any Work within 50 feet of railroad-owned and controlled property, Contractor shall (1) endorse its commercial general liability policy with ISO CG 24 17, removing the contractual liability exclusion for work within 50 feet of a railroad, (2) purchase and maintain railroad protective liability insurance meeting the following requirements, (3) furnish a copy of the endorsement to Owner, and (4) submit a copy of the railroad protective policy and other railroad-required documentation to the railroad, and notify Owner of such submittal.

Railroad Protective Liability Insurance	Policy limits of not less than:
Each Claim	N/A
Aggregate	N/A

P. *Builder's Risk and Other Property Insurance*

1. The Contractor shall purchase and maintain Builder's Risk insurance covering the Work for all projects, unless expressly waived in writing by the Owner. Such insurance shall be written on a completed value basis in an amount equal to 100 percent of the Contract Price and shall remain in effect the Owner had fully and completely accepted the Word.
2. The policy shall be written on an "all-risk" or "special form" basis and shall insure against loss or damage to the Work, including fire, windstorm, theft, vandalism, malicious mischief, collapse, property in transit, and property stored off-site intended for use at the Project.
3. The Owner, Contractor, and all Subcontractors shall be named as insureds.

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4. Contractor shall be responsible for any deductible amounts, which shall not exceed $10,000 per loss without Owner's prior written approval.
5. Builder's Risk Insurance Policy limits of not less than:
    1. Completed Value of the Work (100% of Contract Price)
    2. Deductible: Not to exceed $10,000, Contractor responsible
6. **Continuation of Coverage:** Coverage shall remain in effect until final acceptance by the Owner, regardless of any partial occupancy or use by Owner.
7. **Covered Perils:** The Builder's Risk insurance shall include coverage for windstorm, flood, and earthquake, unless expressly waived in writing by Owner. Coverage shall also extend to loss or damage caused by theft, vandalism, collapse, malicious mischief, property in transit, and property stored off-site intended for use at the Project.
8. **Temporary Works and Testing:** The Builder's Risk insurance shall include coverage for temporary works, scaffolding, formwork, falsework, construction trailers, and similar items incidental to the Work. Coverage shall also apply to mechanical and electrical testing and startup of the building systems.
9. **Coinsurance / Subrogation:** The Builder's Risk policy shall not contain a coinsurance clause. Insurers shall waive all rights of subrogation against Owner, Contractor, Subcontractors, and Engineer.
10. **Change Orders:** The policy shall automatically adjust to reflect increases in the Contract Price by Change Order, without the need for additional endorsement.
11. **Soft Costs (if required by Owner):** The Builder's Risk policy shall include coverage for soft costs and extra expense associated with delay in completion caused by an insured loss, including but not limited to design professional fees, financing costs, and administrative costs, if expressly required in the Contract Documents.

Q. *Indemnification*

1. To the fullest extent permitted by law the Recipient's contractor shall indemnify and hold harmless the Recipient, the State of Florida, and its officers and employees, from liabilities, damages, losses and costs, including, but not limited to, reasonable attorney's fees, to the extent caused by the negligence, recklessness or intentional wrongful misconduct of contractor and persons employed or utilized by contractor in the performance of this Contract. This indemnification shall survive the termination of this Agreement. Nothing contained in this paragraph is intended to nor shall it constitute a waiver of the State of Florida and the Recipient's sovereign immunity. To the fullest extent permitted by law, the Recipient's consultant shall indemnify and hold harmless the Recipient, the State of Florida, and its officers and employees from liabilities, damages, losses, and costs, including, but not limited to, reasonable attorney fees to the extent caused, in whole or in part, by the professional negligence, error or omission, recklessness, or intentional wrongful conduct of the consultant or persons employed or utilized by the

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consultant in the performance of the Agreement. This indemnification shall survive the termination of this Agreement. Nothing contained in this paragraph is intended to nor shall it constitute a waiver of the State of Florida and the Recipient's sovereign immunity.

7. CONTRACTOR'S RESPONSIBILITIES

7.03 *Labor; Working Hours*

SC-7.03 Add the following new subparagraphs immediately after Paragraph 7.03.C:

1. Regular working hours will be **7:00 AM to 5:00 PM** from Monday – Friday.
2. Work outside of these hours must be approved by the Owner.

7.10 *Taxes*

SC-7.10 Add a new paragraph immediately after Paragraph 7.10.A:

B. Owner is exempt from payment of sales and compensating use taxes of the State of **Florida** and of cities and counties thereof on all materials to be incorporated into the Work.

1. Owner will furnish the required certificates of tax exemption to Contractor for use in the purchase of supplies and materials to be incorporated into the Work.
2. Owner's exemption does not apply to construction tools, machinery, equipment, or other property purchased by or leased by Contractor, or to supplies or materials not incorporated into the Work.

8. OTHER WORK AT THE SITE

No suggested Supplementary Conditions in this Article.

9. OWNER'S RESPONSIBILITIES

No suggested Supplementary Conditions in this Article.

10. ENGINEER'S STATUS DURING CONSTRUCTION

10.03 *Resident Project Representative*

SC-10.03 Add the following new paragraphs immediately after Paragraph 10.03.B:

C. The Resident Project Representative (RPR) will be Engineer's representative at the Site. RPR's dealings in matters pertaining to the Work in general will be with Engineer and Contractor. RPR's dealings with Subcontractors will only be through or with the full knowledge or approval of Contractor. The RPR will:

1. *Conferences and Meetings:* Attend meetings with Contractor, such as preconstruction conferences, progress meetings, job conferences, and other Project-related meetings

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(but not including Contractor's safety meetings), and as appropriate prepare and circulate copies of minutes thereof.

2. *Safety Compliance:* Comply with Site safety programs, as they apply to RPR, and if required to do so by such safety programs, receive safety training specifically related to RPR's own personal safety while at the Site.

3. *Liaison*

   a. Serve as Engineer's liaison with Contractor. Working principally through Contractor's authorized representative or designee, assist in providing information regarding the provisions and intent of the Contract Documents.

   b. Assist Engineer in serving as Owner's liaison with Contractor when Contractor's operations affect Owner's on-Site operations.

   c. Assist in obtaining from Owner additional details or information, when required for Contractor's proper execution of the Work.

4. *Review of Work; Defective Work*

   a. Conduct on-Site observations of the Work to assist Engineer in determining, to the extent set forth in Paragraph 10.02, if the Work is in general proceeding in accordance with the Contract Documents.

   b. Observe whether any Work in place appears to be defective.

   c. Observe whether any Work in place should be uncovered for observation, or requires special testing, inspection or approval.

5. *Inspections and Tests*

   a. Observe Contractor-arranged inspections required by Laws and Regulations, including but not limited to those performed by public or other agencies having jurisdiction over the Work.

   b. Accompany visiting inspectors representing public or other agencies having jurisdiction over the Work.

6. *Payment Requests:* Review Applications for Payment with Contractor in an advisory role. Contractor shall be responsible for accuracy of all pay requests.

7. *Completion*

   a. Participate in Engineer's visits regarding Substantial Completion.

   b. Assist in the preparation of a punch list of items to be completed or corrected.

   c. Participate in Engineer's visit to the Site in the company of Owner and Contractor regarding completion of the Work, and prepare a final punch list of items to be completed or corrected by Contractor.

   d. Observe whether items on the final punch list have been completed or corrected.

D. The RPR will not:

1. Authorize any deviation from the Contract Documents or substitution of materials or equipment (including "or-equal" items).

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2. Exceed limitations of Engineer's authority as set forth in the Contract Documents.
3. Undertake any of the responsibilities of Contractor, Subcontractors, or Suppliers.
4. Advise on, issue directions relative to, or assume control over any aspect of the means, methods, techniques, sequences or procedures of construction.
5 Advise on, issue directions regarding, or assume control over security or safety practices, precautions, and programs in connection with the activities or operations of Owner or Contractor.
6. Participate in specialized field or laboratory tests or inspections conducted off-site by others except as specifically authorized by Engineer.
7. Authorize Owner to occupy the Project in whole or in part.

11. CHANGES TO THE CONTRACT

No suggested Supplementary Conditions in this Article.

12. CLAIMS

No suggested Supplementary Conditions in this Article.

13. COST OF WORK; ALLOWANCES, UNIT PRICE WORK

No suggested Supplementary Conditions in this Article.

14. TESTS AND INSPECTIONS; CORRECTION, REMOVAL, OR ACCCEPTANCE OF DEFECTIVE WORK

No suggested Supplementary Conditions in this Article.

15. PAYMENTS TO CONTRACTOR, SET OFFS; COMPLETIONS; CORRECTION PERIOD

15.03 *Substantial Completion*

SC-15.03 Add the following new subparagraph to Paragraph 15.03.B:

1. If some or all of the Work has been determined not to be at a point of Substantial Completion and will require re-inspection or re-testing by Engineer, the cost of such re-inspection or re-testing, including the cost of time, travel and living expenses, shall be borne by Contractor. Owner may deduct such costs directly from any progress payment then or thereafter due, including retainage, without the need for further agreement. If such costs exceed the remaining Contract balance, Contractor shall promptly reimburse Owner upon demand. Such reimbursement obligation shall survive termination or completion of the Contract.

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16. SUSPENSION OF WORK AND TERMINATION

No suggested Supplementary Conditions in this Article.

17. FINAL RESOLUTIONS OF DISPUTES

1. Any dispute between the parties arising out of or relating to the Contract Documents or the Work shall be resolved by a non-jury trial before a judge of the Fourteenth Judicial Circuit, sitting in and for Jackson County, Florida. The parties expressly and mutually waive the right to trial by jury. Exclusive venue and jurisdiction for any such action shall lie solely in Jackson County, Florida. This Contract shall be governed by and construed in accordance with the laws of the State of Florida, without regard to conflict of law principles.

18. MISCELLANEOUS

No suggested Supplementary Conditions in this Article.

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WORK CHANGE DIRECTIVE NO.:

Owner: Owner's Project No.:
Engineer: Engineer's Project No.:
Contractor: Contractor's Project No.:
Project:
Contract Name:
Date Issued: Effective Date of Work Change Directive:

Contractor is directed to proceed promptly with the following change(s):

Description:

Attachments:

Purpose for the Work Change Directive:

Directive to proceed promptly with the Work described herein, prior to agreeing to change in Contract Price and Contract Time, is issued due to:

☐ Non-agreement on pricing of proposed change. ☐ Necessity to proceed for schedule or other reasons.

Estimated Change in Contract Price and Contract Times (non-binding, preliminary):

Contract Price: $ _____ (increase / decrease)

Contract Time: _____ days (increase / decrease)

Basis of estimated change in Contract Price:

☐ Lump Sum ☐ Unit Price ☐ Cost of the Work ☐ Other

	Recommended by Engineer	Authorized by Owner
By:		
Title:		
Date:		

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C-941

CHANGE ORDER NO.:

Owner: Owner's Project No.:
Engineer: Engineer's Project No.:
Contractor: Contractor's Project No.:
Project:
Contract Name:
Date Issued: Effective Date of Change Order:

The Contract is modified as follows upon execution of this Change Order:

Description:

Attachments:

Change in Contract Price	**Change in Contract Times**
Original Contract Price: $	Original Contract Times: Substantial Completion: Ready for final payment:
[Increase] [Decrease] from previously approved Change Orders No. 1 to No. ___: $	[Increase] [Decrease] from previously approved Change Orders No.1 to No. ___: Substantial Completion: Ready for final payment:
Contract Price prior to this Change Order: $	Contract Times prior to this Change Order: Substantial Completion: Ready for final payment:
[Increase] [Decrease] this Change Order: $	[Increase] [Decrease] this Change Order: Substantial Completion: Ready for final payment:
Contract Price incorporating this Change Order: $	Contract Times with all approved Change Orders: Substantial Completion: Ready for final payment:

Recommended by Engineer (if required)	Accepted by Contractor
By:	
Title:	
Date:	
Authorized by Owner	**Approved by Funding Agency (if applicable)**
By:	
Title:	
Date:	

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C-942

FIELD ORDER NO.:

Owner:	Owner's Project No.:
Engineer:	Engineer's Project No.:
Contractor:	Contractor's Project No.:
Project:	
Contract Name:	
Date Issued:	Effective Date of Field Order:

Contractor is hereby directed to promptly perform the Work described in this Field Order, issued in accordance with Paragraph 11.04 of the General Conditions, for minor changes in the Work without changes in Contract Price or Contract Times. If Contractor considers that a change in Contract Price or Contract Times is required, submit a Change Proposal before proceeding with this Work.

Reference:

Specification Section(s):

Drawing(s) / Details (s):

Description:

Attachments:

Issued by Engineer

By: _____

Title: _____

Date: _____

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General Specifications

SECTION 01026

APPLICATIONS FOR PAYMENT

CONTRACTOR'S PREREQUEST

PART 1 - GENERAL

1.1 REQUIREMENTS INCLUDED

Submit Applications for Payment to the Engineer in accord with the schedule established by Conditions of the Contract and Agreement Between Owner and Contractor.

1.2 RELATED REQUIREMENTS

A. Agreement Between Owner and Contractor.

B. Conditions of the Contract: Progress Payments, Retainages and Final Payment.

C. Section 01030: Measurement and Payment.

D. Section 01700: Contract Close-out.

E. Section 01720: Project Record Documents.

1.3 FORMAT AND DATA REQUIRED

A. Submit one application to the Engineer typed on forms provided by the Engineer, Application for Payment, with itemized data typed on 8-1/2 inch x 11 inch or 8-1/2 inch x 14 inch white paper continuation sheets.

B. Fill in required information, including that for Change Orders executed prior to date of submittal of application.

C. Fill in summary of dollar values to agree with respective totals indicated on continuation sheets.

D. Execute certification with signature of a responsible officer of Contract firm.

1.4 PREREQUISITES FOR PAYMENTS

The Contractor shall provide the following as a prerequisite for payment.

A. Exhibit the updated record drawings as required by Section 01720, Project Record Documents, for review by the Engineer.

B. Submit required certificates and evidence of passing test for items for which payment is requested in accordance with the testing requirements in Section 01410, Testing Services.

C. Submit payroll records indicating compliance with Federal Wage Requirements on Form WH347.

D. Submit revised construction schedules in accordance with Section 01310, Construction Schedules.

1.5 SUBMITTAL AND PAYMENT PROCEDURE

A. Contractor's Responsibility

1. In order for progress payments be made to the Contractor, the Owner must request and receive the funds for each progress payment from the Department of Community Affairs (DCA). The process of requesting and receiving funds from DCA requires approximately 45 days. In order to expedite payment to the Contractor, it is recommended that the Contractor notify the Engineer by phone 30 days prior of his intention to submit an Application for Payment and indicate the estimated funds to be requested. This will allow the Engineer to instruct the Owner to proceed with the request for funds from DCA. This will help insure the immediate availability of funds upon the final approval of the actual Application for Payment.

2. Contractor shall satisfy all prerequisites prior to submittal of Application for Payment.

3. Contractor shall submit completed and signed Application for Payment to Engineer. Contractor may submit Application for Payment at any time, however, not more frequently than one per month.

B. Engineer's Responsibility

1. Inform Owner/Grant Administrator of Contractor's advance notice of intention to submit Application for Payment.

2. Review and make recommendation concerning Application for Payment to Owner.

C. Owner's Responsibility

1. Request funds from DCA.

2. Approve Application for Payment.

3. Make a progress payment to the Contractor not later than five (5) days after Owner receives funds from DCA on the basis of a duly certified and approved Application for Payment for the work performed during the preceding interim, but to insure the proper performance of this Contract, the Owner shall retain ten percent (10%) of the amount of each estimate until final completion and acceptance of all work covered by this Contract.

PART 2 - PRODUCT

(Not Used)

PART 3 - EXECUTION

(Not Used)

END OF SECTION

SECTION 01310

CONSTRUCTION SCHEDULES

PART 1 - GENERAL

1.1 REQUIREMENTS INCLUDED

A. Promptly after award of the Contract and within ten days after the effective date of the Agreement, prepare and submit to the Engineer estimated construction progress schedules for the work, with subschedules of related activities which are essential to its progress.

B. Submit revised progress schedules on a monthly basis.

C. No partial payments shall be approved by the Engineer until there is an approved construction progress schedule on hand.

D. The Contractor shall designate an authorized representative of his firm who shall be responsible for development and maintenance of the schedule and of progress and payment reports. This representative of the Contractor shall have direct project control and complete authority to act on behalf of the Contractor in fulfilling the commitments of the Contractor's schedule.

1.2 RELATED REQUIREMENTS

A. Conditions of the Contract.

B. Section 01010: Summary of Work.

1.3 FORM OF SCHEDULES

A. Prepare schedules in the form of a horizontal bar chart.

1. Provide separate horizontal bar for each trade or operation within each structure or item.

2. Horizontal time scale: In weeks from start of construction and identify the first work day of each month.

3. Scale and spacing: To allow space for notations and future revisions.

4. Minimum sheet size: 8-1/2 inches x 14 inches.

B. Format of listings: The chronological order of the start of each item of work for each structure.

C. Identification of listings: By major specification section numbers as applicable and structure.

1.4 CONTENT OF SCHEDULES

A. Construction Progress Schedule:

1. Show the complete sequence of construction by activity.

2. Show the dates for the beginning of, and completion of, each major element of construction in no more than a two-week increment scale. Specifically list, but not limit to:

   a. Site clearing.
   b. Site utilities.
   c. Foundation work.
   d. Structural framing.
   e. Subcontractor work.
   f. Equipment installations.
   g. Finishings.
   h. Instrumentation.
   i. Painting.
   j. Schooling.
   k. Testing.
   l. Start-up.
   m. Receipt of spare parts.
   n. Pipe installation.
   o. Boring and jacking.
   p. Restoration.

3. Show projected percentage of completion for each item, as of the first day of each month.

4. Show projected dollar cash flow requirements for each month of construction.

B. Submittals Schedule for Shop Drawings, and Samples in accordance with Section 01340. Show:

1. The dates for Contractor's submittals.
2. The dates submittals will be required for owner-furnished products, if applicable.
3. The dates approved submittals will be required from the Engineer.

C. A typewritten list of all long-lead items (equipment, materials, etc.).

1.5 PROGRESS REVISIONS

A. Indicate progress of each activity to date of submission.
B. Show changes occurring since previous submission of schedule:

1. Major changes in scope.
2. Activities modified since previous submission.
3. Revised projections of progress and completion.
4. Other identifiable changes.

C. Provide a narrative report as needed to define:

1. Problem areas, anticipated delays, and the impact on the schedule.
2. Corrective action recommended, and its effect.

3. The effect of changes on schedules of other prime Contractors.

1.6 SUBMISSIONS

A. Submit initial schedules to the Engineer within 10 days after the effective date of the Agreement.

1. The Engineer will review schedules and return review copy within 21 days after receipt.
2. If required, resubmit within 7 days after return of review copy.

B. Submit revised monthly progress schedules with that month's application for payment.

C. Submit one copy.

1.7 DISTRIBUTION

A. Distribute copies of the revised schedules to:

1. Engineer.
2. Job site file.
3. Subcontractors.
4. Other concerned parties.
5. Owner (two copies).

B. Instruct recipients to report promptly to the Contractor, in writing, any problems anticipated by the projections shown in the schedules.

PART 2 - PRODUCTS

(Not Used)

PART 3 - EXECUTION

(Not Used)

END OF SECTION

SECTION 01340

SHOP DRAWINGS, WORKING DRAWINGS, AND SAMPLES

PART 1 - GENERAL

1.1 REQUIREMENTS INCLUDED

A. The Contractor shall submit to the Engineer for review and exception, if any, such working drawings, shop drawings, test reports and data on materials and equipment (hereinafter in this article called data), and material samples (hereinafter in this article called samples) as are required for the proper control of work, including but not limited to those working drawings, shop drawings, data and samples for materials and equipment specified elsewhere in the Specifications and in the Contract Drawings.

B. Within thirty (30) calendar days after the effective date of the Agreement, the Contractor shall submit to the Engineer a complete list of preliminary data on items for which shop drawings are to be submitted. Included in this list shall be the names of all proposed manufacturers furnishing specified items. Review of this list by the Engineer shall in no way expressed or implied relieve the Contractor from submitting complete shop drawings and providing materials, equipment, etc., fully in accordance with the Specifications. This procedure is required in order to expedite final review of shop drawings.

C. The Contractor is to maintain an accurate updated submittal log and will bring this log to each scheduled progress meeting with the Owner and the Engineer. This log should include the following items:

1. Submittal-Description and Number assigned.
2. Date to Engineer.
3. Date returned to Contractor (from Engineer).
4. Status of Submittal (Approved/Resubmit/Rejected).
5. Date of Resubmittal and Return (as applicable).
6. Date material released (for fabrication).
7. Projected data of fabrication.
8. Projected date of delivery to site.
9. Status of O&M submittal.

D. Shop drawings to be submitted shall include but not necessarily be limited to:

1. Concrete design mix(es);
2. Each item of equipment and/or material listed in the equipment and material schedule;
3. Each item of process instrumentation and control system including system schematic diagrams;
4. Prestressed and precast concrete members;
5. Reinforcing steel;
6. Structural steel fabrications;
7. Miscellaneous metals fabrications and castings;
8. Paintings and coatings system;
9. Electrical fixtures hardware and panels;
10. Piping and duct work, layout and dimension drawings.

1.2 RELATED REQUIREMENTS

A. Section 00700: Standard General Conditions of the Construction Contract.

B. Section 01310: Construction Schedules.

C. Section 01720: Project Record Documents.

D. Section 01730: Operating and Maintenance Data.

E. Designate in the construction schedule, or in a separate coordinated schedule, the dates for submission and the dates that the reviewed shop drawings, working drawings and samples will be needed.

1.3 CONTRACTOR'S RESPONSIBILITY

A. It is the duty of the Contractor to check all drawings, data and samples prepared by or for him before submitting them to the Engineer for review. Each and every copy of the drawings and data shall bear Contractor's stamp showing that they have been so checked. Shop drawings submitted to the Engineer without the Contractor's stamp will be returned to the Contractor for conformance with this requirement. Shop drawings shall indicate any deviations in the submittal from requirements of the Contract Documents.

B. Determine and verify:

1. Field measurements.
2. Field construction criteria.
3. Catalog numbers and similar data.
4. Conformance with Specifications.

C. The Contractor shall furnish the Engineer a schedule of shop drawing submittals fixing the respective dates for the submission of shop and working drawings, the beginning of manufacture, testing and installation of materials, supplies and equipment. This schedule shall indicate those that are critical to the progress schedule.

D. The Contractor shall not begin any of the work covered by a drawing, data, or a sample returned for correction until a revision or correction thereof has been reviewed and returned to him, by the Engineer, approved.

E. The Contractor shall submit to the Engineer all drawings and schedules sufficiently in advance of construction requirements to provide no less than twenty-one (21) calendar days for checking and appropriate action from the time the Engineer receives them.

F. The Contractor shall submit two (2) copies of descriptive or product data submittals to complement shop drawings for the Engineer plus the number of copies which the Contractor requires. The Engineer will retain two (2) sets.

G. The Contractor shall clearly delineate each variation from the Contract Specifications and Drawings within a shop drawing submittal and request a deviation from the Contract Documents. Contractor shall clearly state why such a variation is requested. Request for variance and its documentation shall be noted in and attached to the Contractor's Letter of Transmittal of the shop drawing to be considered.

H. The Contractor shall be responsible for and bear all cost of damages which may result from the ordering of any material or from proceeding with any part of work prior to the review by the Engineer or the necessary shop drawings.

1.4 ENGINEER'S REVIEW OF SHOP DRAWINGS

A. The Engineer's review of drawings, data and samples submitted by the Contractor will cover only general conformity to the Specifications, external connections, and dimensions which affect the installation. The Engineer's review and exception, if any, will not constitute an approval of dimensions, quantities, and details of the material, equipment, device, or item shown.

B. The review of drawings and schedules will be general, and shall not be construed:

1. as permitting any departure from the Contract requirements;
2. as relieving the Contractor of responsibility for any errors, including details, dimensions, and materials;
3. as approving departures from details furnished by the Engineer, except as otherwise provided herein.

C. If the drawings or schedules as submitted describe variations per subparagraph 1.5.D., and show a departure from the Contract requirements which the Engineer finds to be in the interest of the Owner and to be so minor as not to involve a change in Contract Price or time for performance, the Engineer may return the reviewed drawings without noting an exception.

D. When reviewed by the Engineer, each of the shop drawings will be identified as having received such review being so stamped and dated. Shop drawings stamped "REJECTED" and with required corrections shown will be returned to the Contractor for correction and resubmittal.

E. Resubmittals will be handled in the same manner as first submittals. On resubmittals the Contractor shall direct specific attention, in writing or on resubmitted shop drawings, to revisions other than the corrections requested by the Engineer on previous submissions. The Contractor shall make any corrections required by the Engineer.

F. If the Contractor considers any correction indicated on the drawings to constitute a change to the Contract Drawings or Specifications, the Contractor shall give written notice thereof to the Engineer.

G. The Engineer will review a submittal/resubmittal a maximum of three (3) times after which cost of review will be borne by the Contractor. The cost of engineering shall be equal to the Engineer's charges to the Owner under the terms of the Engineer's agreement with the Owner.

H. When the shop drawings have been completed to the satisfaction of the Engineer, the Contractor shall carry out the construction in accordance therewith and shall make no further changes therein except upon written instructions from the Engineer.

I. No partial submittals will be reviewed. Submittals not complete will be returned to the Contractor, and will be considered "REJECTED" until resubmitted.

1.5 SHOP DRAWINGS

A. When used in the Contract Documents, the term "shop drawings" shall be considered to mean Contractor's plans for material and equipment which become an integral part of the Project. These drawings shall be complete and detailed. Shop drawings shall consist of fabrication, erection and setting drawings and schedule drawings, manufacturer's scale drawings, and wiring and control diagrams. Cuts, catalogs, pamphlets, descriptive literature, and performance and test data, shall be considered only as supportive to required shop drawings as defined above.

B. Drawings and schedules shall be checked and coordinated with the work of all trades involved, before they are submitted for review by the Engineer and shall bear the Contractor's stamp of approval as evidence of such checking and coordination. Drawings or schedules submitted without this stamp of approval shall be returned to the Contractor for resubmission.

C. Each shop drawing shall have a blank area 3-1/2 inches by 3-1/2 inches, located adjacent to the title block. The title block shall display the following:

1. Number and title of the drawing.
2. Date of drawing or revision.
3. Name of project building or facility.
4. Name of contractor and subcontractor submitting drawing.
5. Clear identification of contents and location of the work.
6. Specification title and number.

D. If drawings show variations from Contract requirements because of standard shop practice or for other reasons, the Contractor shall describe such variations in his letter of transmittal. If acceptable, proper adjustment in the Contract shall be implemented where appropriate. If the Contractor fails to describe such variations he shall not be relieved of the responsibility for executing the work in accordance with the Contract, even though such drawings have been reviewed.

E. Data on materials and equipment include, without limitation, materials and equipment lists, catalog data sheets, cuts, performance curves, diagrams, materials of construction and similar descriptive material. Materials and equipment lists shall give, for each item thereon, the name and location of the supplier or

manufacturer, trade name, catalog references, size, finish and all other pertinent data.

F. All data submitted to the Engineer for approval shall be completely legible and shall clearly delineate items for which approval is sought; strike out or otherwise obliterate those items which are not applicable to this specific project.

G. For all mechanical and electrical equipment furnished, the Contractor shall provide a list including the equipment name, and address and telephone number of the manufacturer's representative and service company so that service and/or spare parts can be readily obtained. In addition, a maintenance and lubrication schedule for each piece of equipment shall be submitted along with each shop drawing submittal. This schedule shall be in the tablet form.

H. All manufacturers or equipment suppliers who propose to furnish equipment or products under Divisions 11, 12, 13, 14, 15 and 16 shall submit an installation list to the Engineer along with the required shop drawings. The installation list shall include at least five installations where identical equipment has been installed and has been in operation for a period of at least one (1) year.

I. Only the Engineer will utilize the color "red" in marking shop drawing submittals.

J. Before final payment is made, the Contractor shall furnish to Engineer two (2) sets of record shop drawings all clearly revised, complete and up to date showing the permanent construction as actually made for all reinforcing and structural steel, miscellaneous metals, process and mechanical equipment, yard piping, electrical system and instrumentation system.

1.6 WORKING DRAWINGS

A. When used in the Contract Documents, the term "working drawings" shall be considered to mean the Contractor's plans for temporary structures such as temporary bulkheads, support of open cut excavation, support of utilities, ground water control systems, forming and falsework; for underpinning; and for such other work as may be required for construction but does not become an integral part of the Project.

B. Copies of working drawings as noted in subparagraph 1.6.A. above, shall be submitted to the Engineer where required by the Contract Documents or requested by the Engineer, and shall be submitted at least thirty (30) calendar days (unless otherwise specified by the Engineer) in advance of their being required for work.

C. Working drawings shall be signed by a registered Professional Engineer, currently licensed to practice in the State of Florida and shall convey, or be accompanied by, calculation or other sufficient information to completely explain the structure, machine, or system described and its intended manner of use. Prior to commencing such work, working drawings must have been reviewed without specific exceptions by the Engineer, which review will be for general conformance and will not relieve the Contractor in any way from his responsibility with regard to the fulfillment of the terms of the Contract. All risks of error are assumed by the Contractor; the Owner and Engineer shall have no responsibility therefor.

1.7 SAMPLES

A. The Contractor shall furnish, for the approval of the Engineer, samples required by the Contract Documents or requested by the Engineer. Samples shall be delivered to the Engineer as specified or directed. The Contractor shall prepay all shipping charges on samples. Materials or equipment for which samples are required shall not be used in work until approved by the Engineer.

B. Samples shall be of sufficient size and quantity to clearly illustrate:

1. Functional characteristics of the product, with integrally related parts and attachment devices.
2. Full range of color, texture and pattern.
3. A minimum of two samples of each item shall be submitted.

C. Each sample shall have a label indicating:

1. Name of Project.
2. Name of Contractor and Subcontractor.
3. Material or Equipment Represented.
4. Place of Origin.
5. Name of Producer and Brand (if any).
6. Location of Project.

(Samples of finished materials shall have additional markings that will identify them under the finished schedules.)

D. The Contractor shall prepare a transmittal letter in triplicate for each shipment of samples containing the information required in subparagraph 1.7.B. above. He shall enclose a copy of this letter with the shipment and send a copy of this letter to the Engineer. Approval of a sample shall be only for the characteristics or use named in such approval and shall not be construed to change or modify any Contract requirements.

E. Approved samples not destroyed in testing shall be sent to the Engineer or stored at the site of the work. Approved samples of the hardware in good condition will be marked for identification and may be used in the work. Materials and equipment incorporated in work shall match the approved samples. Samples which failed testing or were not approved will be returned to the Contractor at his expense, if so requested at time of submission.

PART 2 - PRODUCTS

(Not Used)

PART 3 - EXECUTION

(Not Used)

END OF SECTION

SECTION 01580

PROJECT IDENTIFICATION SIGN

PART 1 - GENERAL

1.1 REQUIREMENTS

A. Contractor shall furnish, install and maintain a 4' x 8' project identification sign.

B. The sign shall remain in place and become the property of the owner upon completion of construction.

C. The sign shall be complete and properly installed no later than 20 days beyond the date of notice to proceed.

D. The engineer shall furnish contractor with lettering information for the sign.

1.2 QUALITY ASSURANCE

A. Sign Painter: Professional Experience in type of work required.

B. Finishes, Painting: Adequate to resist weathering and fading for a two (2) year period.

PART 2 - PRODUCTS

2.1 SIGN MATERIALS

A. Structure and Framing: Shall be new pressure treated wood, in sound condition structurally adequate to work and suitable for specified finish. The sign shall be supported by 4" x 4" posts with a 2" x 4" frame.

B. Sign Surfaces: Exterior 3/4 inch type A-C softwood plywood.

C. Rough Hardware and Nails: Galvanized.

D. Paint: Exterior quality enamel paint.

PART 3 - EXECUTION

3.1 PROJECT IDENTIFICATION SIGN

A. Contractor shall construct project sign as shown on the drawings or as described herein.

B. Paint exposed surfaces of supports, framing and surface material; one coat of primer and one coat of white exterior paint.

C. Paint graphics in blue exterior paint in block style in the sizes shown on the drawings or as furnished by the Engineer.

D. Erect signs in the numbers and locations stated below, in areas at high public visibility, as approved by the Engineer and Owner.

3.2 MAINTENANCE

Maintain signs and supports in a neat, clean condition; repair damages to structure, framing or sign.

3.3 REMOVAL

Contractor shall not remove signs. Sign shall become property of the owner.

END OF SECTION

SECTION 01700

CONTRACT CLOSE-OUT

PART 1 - GENERAL

1.1 REQUIREMENTS INCLUDED

Comply with requirements stated in Conditions of the Contract and in Specifications for administrative procedures in closing out the Work.

1.2 RELATED REQUIREMENTS

A. Conditions of the Contract. Fiscal provisions, legal submittals and additional administrative requirements.

B. Section 01720: Project Record Documents.

C. Section 01730: Operating and Maintenance Data.

D. Section 01740 and/or Section 01742: Warranties and Bonds.

E. The respective sections of Specification: Close-out Submittals Required of Trades.

1.3 SUBSTANTIAL COMPLETION

A. When Contractor considers the Work is substantially complete, he shall submit to the Engineer:

1. A written notice that the Work, or designated portion thereof, is ready for a substantial completion inspection.
2. A list of items to be completed or corrected.

B. Within a reasonable time after receipt of such notice, the Engineer will make an inspection to determine the status of completion.

C. Should the Engineer determine that the Work is not substantially complete:

1. The Engineer will promptly notify the Contractor, in writing, giving the reasons therefor.
2. Contractor shall remedy the deficiencies in the Work, and send a second written notice of substantial completion to the Engineer.
3. The Engineer will reinspect the Work.

D. When the Engineer finds that the Work is substantially complete, he will:

1. Prepare and deliver to Owner a tentative Certificate of Substantial Completion found in Section 00640, with a tentative list "punch list" of items to be completed or corrected before final payment.
2. After consideration of any objections made by the Owner as provided in Conditions of the Contract, and when the Engineer considers the Work substantially complete, he will execute and deliver to the Owner and the Contractor a definite Certificate of Substantial Completion with a revised punch list of items to be completed or corrected.

1.4 FINAL INSPECTION

A. When Contractor considers the Work is complete, he shall submit written certification that:

1. Contract Documents have been reviewed.
2. Work has been inspected for compliance with Contract Documents.
3. Work has been completed in accordance with Contract Documents.
4. Equipment and systems have been tested in the presence of the Owner's representative and are operational.
5. Work is completed and ready for final inspection.

B. The Engineer will make an inspection to verify the status of completion with reasonable promptness after receipt of such certification.

C. Should the Engineer consider that the Work is incomplete or defective:

1. The Engineer will promptly notify the Contractor, in writing, listing the incomplete or defective Work.
2. Contractor shall take immediate steps to remedy the stated deficiencies, and send a second written certification to the Engineer that the Work is complete.
3. The Engineer will reinspect the Work.

D. When the Engineer finds that the Work is acceptable under the Contract Documents, he shall request the Contractor to make close-out submittals.

1.5 REINSPECTION FEES

A. Should the Engineer perform reinspections due to failure of the Work to comply with the claims of status of completion made by the Contractor:

1. Owner will compensate the Engineer for such additional services.
2. Owner will deduct the amount of such compensation from the final payment to the

Contractor.

1.6 CONTRACTOR'S CLOSE-OUT SUBMITTALS TO ENGINEER

A. Evidence of compliance with requirements of governing authorities.

B. Project Record Documents: To requirements of Section 01720.

C. Operating and Maintenance Data, Instructions to Owner's Personnel: To requirements of Section 01730.

D. Warranties and Bonds: To requirements of Section 01740 and Section 01742.

E. Keys and Keying Schedule.

F. Spare Parts and Maintenance Materials: To requirements of Section 01730.

G. Evidence of Payment and Release of Liens: To requirements of General and Supplementary Conditions.

H. Certificate of Insurance for Products and Completed Operations.

1.7 FINAL ADJUSTMENT OF ACCOUNTS

A. Submit a final statement of accounting to the Engineer.

B. Statement shall reflect all adjustments to the Contract Sum:

1. The original Contract Sum.
2. Additions and deductions resulting from:

    a. Previous Change Orders.
    b. Allowances.
    c. Unit Prices.
    d. Deductions for uncorrected Work.
    e. Penalties and Bonuses.
    f. Deductions for liquidated damages.
    g. Deductions for reinspection payments.
    h. Other adjustments.

3. Total Contract Sum, as adjusted.
4. Previous payments.
5. Sum remaining due.

C. Engineer will prepare a final Change Order, reflecting approved adjustments to the Contract Sum which were not previously made by Change Orders.

1.8 FINAL APPLICATION FOR PAYMENT

Contractor shall submit the final Application for Payment in accordance with procedures and

requirements stated in the Conditions of the Contract.

PART 2 - PRODUCTS

(Not Used)

PART 3 - EXECUTION

(Not Used)

END OF SECTION

SECTION 01730

OPERATION AND MAINTENANCE MANUALS

Part 1 - General

1.1 SCOPE OF WORK

The work under this section includes the furnishings bound manuals of instruction on the operation and maintenance of the equipment, treatment plant, pump stations, and all appurtenances installed under these specifications.

1.2 OPERATING AND MAINTENANCE DATA

A. REQUIREMENTS INCLUDED:

1. Compile product data and related information appropriate for Owner's maintenance and operation of products furnished under Contract and furnish an operation and maintenance manual in accordance with this section.

2. Preparation of data shall be done by personnel:

   a. Trained and experienced in maintenance and operation of described products.

   b. Familiar with requirements of this Section.

   c. Skilled as technical writer to the extent required to communicate essential data to personnel unfamiliar with the equipment being discussed.

   d. Skilled as draftsman competent to prepare required drawings.

3. Instruct Owner's personnel in maintenance of products and in operation of equipment and systems.

B. RELATED REQUIREMENTS:

1. Section 01340: Shop Drawings, Working Drawings & Samples

2. Section 01700: Contract Closeout

3. Section 01720: Project Record Documents

4. Section 01740: Warranties & Bonds

C. FORM OF SUBMITTALS:

1. Prepare data in form of an instructional manual for use by Owner's personnel.

2. Format:

a. Size: 8-1/2 inches x 11 inches.

b. Paper: 20 pound minimum white, for typed pages.

c. Text: Manufacturer's printed data, or neatly typewritten.

3. Drawings:

a. Provide reinforced punched binder tab, bind in with text.

b. Reduce larger drawings and fold to size of text pages but not larger than 14 inches x 17 inches.

4. Provide fly-leaf for each separate product, or each piece of operating equipment.

a. Provide typed description of product, and major component parts of equipment.

b. Provide indexed tabs.

5. Cover: Identify each volume with typed or printed title "OPERATING AND MAINTENANCE INSTRUCTIONS". List:

a. Title of Project.

b. Identity of separate structure as applicable.

c. Identity of general subject matter covered in the manual.

6. Binders:

a. Commercial quality three-post binders with durable and cleanable plastic covers.

b. Maximum post width: 2 inches.

c. When multiple binders are used, correlate the data into related consistent groupings.

D. CONTENT OF MANUAL

1. Neatly typewritten table of contents for each volume, arranged in systematic order.

a. Contractor, name of responsible principal, address and telephone number.

b. A list of each product required to be included, indexed to content of the volume.

c. Identify each product by product name and other identifying symbols as set forth in Contract Documents.

d. List, with each product, name, address and telephone number of:

1. Subcontractor or installer.
2. Maintenance contractor, as appropriate.
3. Identify area of responsibility of each.
4. Local source of supply for parts and replacement.

2. Product Data

a. Include only those sheets which are pertinent to the specific product.

b. Annotate each sheet to:

1. Clearly identify specific product or part installed.
2. Clearly identify data applicable to installation.
3. Delete references to inapplicable information.

3. Drawings

a. Supplement product data with drawings as necessary to clearly illustrate relations of component parts of equipment and systems, and control and flow diagrams.

b. Coordinate drawings with information in Project Record Documents to assure correct illustration of completed installation.

c. Do not use Project Record Documents as maintenance drawings.

4. Written test, as required to supplement product data for the particular installation:

a. Organize in consistent format under separate headings for different procedures.

b. Provide logical sequence of instructions of each procedure.

5. Copy of each warranty, bond and service contract issued.

a. Provide information sheet for Owner's personnel, give:

1. Proper procedures in event of failure.
2. Instances which might affect validity of warranties or bonds.

E. SUBMITTAL SCHEDULE:

1. Submit two copies of preliminary draft of proposed formats and outlines of contents of Operation and Maintenance Manuals within 30 days after Notice to Proceed.

a. The Engineer will review the preliminary draft and return one copy with comments.

2. Submit two copies of completed data in final form no later than 30 days following the Engineer's review of the last shop drawing and/or other submittal specified under Section 01340.

a. One copy will be returned with comments to be incorporated into final copies.

3. Submit five (5) copies of complete manual in final form directly to the office of the Engineer within 30 calendar days of product shipment to the project site and preferably within 30 days after the reviewed copy is received.

4. Submit five (5) copies of addendum to the operation and maintenance manuals as applicable and certifications within 30 days after final inspection and plant start-up test.

F. INSTRUCTION OF OWNER'S PERSONNEL:

1. Prior to final inspection or acceptance, fully instruct Owner's designated operating and maintenance personnel in operation, adjustment and maintenance of products, equipment and systems.

2. Operating and maintenance manual shall constitute the basis of instruction.

a. Review contents of manual with personnel in full detail to explain all aspects of operations and maintenance.

1.5 BASIS OF PAYMENT

No separate payment will be made for work accomplished under this section of the Specifications. Compensation for these items shall be included in the appropriate pay item with which they are associated.

PART 2 - PRODUCTS

(NOT USED)

PART 3 - EXECUTION

(NOT USED)

END OF SECTION

SECTION 01740

WARRANTIES AND BONDS

PART 1 - GENERAL

1.1 REQUIREMENTS INCLUDED

A. Compile specified warranties and bonds, as in the General Conditions.

B. Co-execute submittals when so specified.

C. Review submittals to verify compliance with Contract Documents.

D. Submit to the Engineer for review and transmittal to Owner.

1.2 RELATED REQUIREMENTS

A. Instructions to Bidders: Bid or Proposal Bonds.

B. Conditions of the Contract: Performance Bond and Payment Bond.

C. Section 00700: General Conditions.

D. Section 01700: Contract Close-out.

1.3 SUBMITTAL REQUIREMENTS

A. Assemble warranties, bonds and service and maintenance contracts, executed by each of the respective manufacturers, suppliers, and subcontractors.

B. Number of original signed copies required: Two each.

C. Table of Contents: Neatly typed, in orderly sequence. Provide complete information for each item.

1. Product or work item.

2. Firm, with name of principal, address and telephone number.

3. Scope.

4. Date of beginning of warranty, bond or service and maintenance contract.

5. Duration of warranty, bond or service maintenance contract.

6. Provide information for Owner's personnel:

   a. Proper procedure in case of failure.

   b. Instances which might affect the validity of warranty or bond.

7. Contractor, name of responsible principal, address and telephone number.

1.4 FORM OF SUBMITTALS

A. Prepare in duplicate packets.

B. Format:

1. Size 8-1/2 inches x 11 inches, punch sheets for standard 3-post binder.

   a. Fold larger sheets to fit into binders.

2. Cover: Identify each packet with typed or printed title "WARRANTIES AND BONDS". List:

   a. Title of Project.

   b. Name of Contractor.

C. Binders: Commercial quality, three-post binder, with durable and cleanable plastic covers and maximum post width of 2 inches.

1.5 WARRANTY SUBMITTAL REQUIREMENTS

A. For all major pieces of equipment, submit a warranty from the equipment manufacturer. The manufacturer's warranty period shall be concurrent with the Contractor's for one (1) year commencing at the time of acceptance by the Owner (see Section 01700).

B. The Contractor shall be responsible for obtaining certificates for equipment warranty for all major equipment specified under Division 11, 13, 14, 15 and 16 and which has a 1 HP motor or larger or which lists for more than $1,000. The Engineer reserves the right to request warranties for equipment not classified as major. The Contractor shall still warrant equipment not considered to be "major" in the Contractor's one-year warranty period even though certificates of warranty may not be required.

C. In the event that the equipment manufacturer or supplier is unwilling to provide a one-year warranty commencing at the time of Owner acceptance, the Contractor shall obtain from the manufacturer a two (2) year warranty commencing at the time of equipment delivery to the job site. This two-year warranty from the manufacturer shall not relieve the Contractor of the one-year warranty starting at the time of the Owner acceptance of the equipment.

PART 2 - PRODUCTS

(Not Used)

PART 3 - EXECUTION

(Not Used)

END OF SECTION

Technical Specifications

SECTION 6A

CARPENTRY, MILLWORK, AND INSULATION

6A-01. GENERAL CONDITIONS:

The General and Special Conditions Division II, Sections E and F of these specifications shall apply to and form a part of this Section as if written in full herein.

6A-02. SCOPE:

The contractor shall furnish all labor and materials for carpentry, millwork and case work as indicated on drawings or specified or reasonably required to finish the work. Work under this heading shall be properly coordinated with all other trades. The carpenter shall do all cutting and fitting for carpentry and millwork, and render all such other assistance required for other branches of the work, making good after other mechanics.

6A-03. LUMBER, IN GENERAL:

All lumber shall be thoroughly seasoned and dried to a moisture content of not over 10% for framing lumber and not over 12% for millwork, and when delivered shall be stored and protected to keep same dry.

All lumber for any purpose shall be dressed four (4) sides, unless otherwise noted and be free from holes, large loose knots, bark and large pitch streaks, regardless of grade.

Grading shall be according to grading rules of the Southern Pine Inspection Bureau under which it is manufactured and each piece of bundle, if bundled stock, shall bear an Inspection Bureau's mark, indicating the grade.

Doors, trim, and millwork in general shall not be stored in the building while the building is damp or in any damp storage location.

6A-04. LUMBER GRADES:

All trim shall be as indicated on drawings. All blocking “cant” strips, grounds or nailers shall be pressure treated No. 2 grade, Yellow Pine; wood studs and wood joists shall be Fir or Yellow Pine structural grade.

6A-05. TREATED LUMBER:

A. Structural Lumber: Give all nailers, blocking and wood grounds in contact with exterior masonry, concrete, roof slabs or steel, pressure preventative treatment in closed retort as per FS TT-W-571; minimum net preservatives as specified herein. Any of the following preservatives will be acceptable:

Preservative	Lbs. Per Cu. Ft.
Pentachlorophenol (5% solution in oil)	Solution 6.0
Zinc Chloride	Dry Salt 1.0
Zinc Metal Arsenite (ZMA)	Dry Salt .03
Wolman Salts (Tanalith)	Dry Salt 0.3
Chromated Zinc Chloride	Dry Salt 0.75

After using the salt treatment, reduce lumber moisture content to not over 10%. Brush coat surfaces of lumber sawed, bored or cut, after treatment with same preservative used at plant. Accompany lumber with certificates from lumber treatment company, certifying treatment amount, moisture percentage after kiln drying. Architect reserves the right to apply method for determining penetrating as per manual issued by the American Wood Preserver's Association. Treatment shall be arsenic free.

6A-06. METAL GLASS STOPS:

All wood doors shown or noted with glass lights shall have metal stops. Stops shall be Type FGS75 for single glazing and shall be as manufactured by Anemostat Door Products. **Install stops with stainless steel through bolts.**

6A-07. MILLWORK:

Millwork shall be of material and manufacturer hereinafter specified and as indicated on the drawings and shown on details. In all cases millwork shall be of good standard construction. All joints shall be made in approved manner perfectly fitted. Secure with finishing nails with heads set for putty, and with screws and glue where required. All surfaces sanded smooth.

All trim and moldings shall be mitered at joints and corners and in full lengths within the limits of the material.

No sheet plywood shall be less than ¼" thick, exposed surfaces, Grade A. Frames shall be primed on all sides at the mill with clear primer.

6A-08. TRIM:

Trim shall be as indicated on drawings or if not noted shall match species of doors, siding, and paneling used. All other trim shall be as specified above, No. 1 Fir. All cuts in trim shall be painted with clear Rez during erection. All trim work including bonding on cabinets and cabinet work shall have mitered corners.

6A-09. SOLID SURFACE MATERIAL:

A. Where noted on the drawing Corian for counter tops and splash material shall be Corian Solid Surface as manufactured by Dupont. Color and pattern shall be selected by the Architect. Sheets for horizontal surface and back splashes shall be ½". Seams shall be made as specified by manufacturer using manufacturer's joint adhesive.

B. Submit samples for color and pattern selection.

6A-10. ROUGH HARDWARE:

The contractor shall furnish all nails, screws, bolts and fittings required to fabricate and install his work in place of the character required and best suited to the conditions of the work.

6A-11. APPLICATION OF FINISH HARDWARE:

Finish hardware is specified under another Section. Fit and apply all finish hardware to wood doors and leave same in operating order. All mortises, sinkages and cuts shall be accurately made to fit or be covered by hardware. Screws shall be counter sunk or counter bored and plugged as specified. All screws shall be screwed in place and not hammered. (After the finish hardware has been fitted, remove the same until the painter has applied the last coat of paint on every surface, then reset in place.) See the Carpet Section and Finish Hardware Section for aluminum saddles at doors between corridors and rooms.

6A-12. WOOD DOORS: See Drawings.

6A-13. DOOR LOUVERS:

All door louvers are to be furnished by others and installed by this Contractor.

6A-14. CAULKING:

Where backsplashes and/or countertops finish against plastic walls, the joint shall be caulked with a Thiokol caulking compound before painting.

6A-15. PLYWOOD:

All plywood shall have markings stamped on sheets for grades and thicknesses called for. Where used for exterior applications, plywood is to be exterior grade with exterior glue.

6A-16. ROOF INSULATION: **N.A.**

6A-16.1 SPRAY FOAM INSULATION:

A. Scope: Furnish and install medium density open cell spray foam insulation at the bottom of metal roof and floor decks as indicated on drawings.

B. Product Description: Icynene LD-C-50, medium density, two-component, open-cell, polyurethane foam plastic insulation and air barrier, which is 100% water blown. The two components of the spray applied product are polymeric isocyanate and a proprietary resin.

C. Product Characteristics:

1.	Normal Density	.5pcf
2.	Surface Burning	Flame spread index of less than 25 in accordance with

		ASTM E 84 / UL 723 Smoke development index of less than 450 in accordance with ASTM E 84 / UL 723
3.	Thermal Resistance	R value equal to 3.7 / inch thickness
4.	Air Permeability	At minimum thickness of 3 ½", is considered air impermeable in accordance with ASTM E 283

Application: Apply and install Icynene LD-C-50 in strict accordance with all published manufacturers' installation instructions. Icynene LD-C-50 must be applied using spray equipment specified and approved by Icynene Inc. The insulation can be installed one pass to the maximum thickness. Where multiple passes are required, cure time in between passes is negligible.

6A-17. EXTERIOR WALL CAVITY INSULATION: **N.A.**

Masonry Cavity Insulation: Provide and install at all cavities in between face brick veneer and concrete block masonry units high performance rigid insulation equal to R-Techx as manufactured by insulfoam (a Carisle Company)

Rigid insulation shall be closed cell, lightweight, resilient expanded polystyrene with advanced polymeric laminate facing.

Rigid insulation shall be 1 ½" thick x 4'0" x 8'0" and shall be provided with an insul snap feature allowing clean break of sheet into (3) 16" x 8'0" long sheets. Product shall provide an effective and stable R-value of 9.9 at 40 ° F.

Product shall meet or exceed compressive strength, flexural strength, dimensional stability and water absorption requirements as set forth in ASTM C578, type x standard specification for rigid, cellular, polystyrene thermal insulation.

6A-18. INTERIOR WALL SOUND BATTS:

Install interior wall sound batts at interior metal stud framed wall construction as shown in drawings equal to un-faced sound attenuation batts fiber glass as manufactured by Owens Corning with the following characteristics:

Thickness:3 ½" Width:16" Length:96"

Surface Burning Characteristics / Rating:	Flame Spread Rating	10
	Smoke Developed Rating	10
Acoustical Performances:	N.R.C. (Noise Reduction Coefficient)	1
Thermal Performance:	R-Value	11

6A-19. INTERIOR CEILING SOUND BATTS: **N.A.**

6A-19. CLEAN-UP:

The Contractor shall remove all debris, scrap, etc., from the site upon completion of his work. Tile shall be free of al fingerprints, smudges, and present a uniform color, clean, and level. Any tile found to contain smudges, chips, etc., shall be removed and replaced with a new tile.

6A-20. GUARANTEE:

This contractor shall guarantee in writing the materials and workmanship for a period of two (2) years after final acceptance of the building.

END OF SECTION.

SECTION C
HOLLOW METAL DOORS AND FRAMES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Standard and custom hollow metal doors and frames.
2. Steel sidelight, borrowed lite and transom frames.
3. Louvers installed in hollow metal doors.
4. Light frames and glazing installed in hollow metal doors.

B. Related Sections:

1. Division 01 Section "General Conditions".
2. Division 04 Section "Unit Masonry" for embedding anchors for hollow metal work into masonry construction.
3. Division 08 Section “Flush Wood Doors”.
4. Division 08 Section "Glazing" for glass view panels in hollow metal doors.
5. Division 08 Section "Door Hardware".
6. Division 09 Sections "Exterior Painting" and "Interior Painting" for field painting hollow metal doors and frames.

C. Codes and References: Comply with the version year adopted by the Authority Having Jurisdiction.

1. ANSI/SDI A250.8 - Recommended Specifications for Standard Steel Doors and Frames.
2. ANSI/SDI A250.4 - Test Procedure and Acceptance Criteria for Physical Endurance for Steel Doors, Frames, Frames Anchors and Hardware Reinforcing.
3. ANSI/SDI A250.6 - Recommended Practice for Hardware Reinforcing on Standard Steel Doors and Frames.
4. ANSI/SDI A250.10 - Test Procedure and Acceptance Criteria for Prime Painted Steel Surfaces for Steel Doors and Frames.
5. ANSI/SDI A250.11 - Recommended Erection Instructions for Steel Frames.
6. ANSI/SDI A250.13 - Testing and Rating of Severe Windstorm Resistant Components for Swing Door Assemblies.
7. ASTM A1008 - Standard Specification for Steel Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability.
8. ASTM A653 - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
9. ASTM A924 - Standard Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process.
10. 10. SDI-113 Standard Practice for Determining the Steady-State Thermal Transmittance of Steel Door & Frame Assemblies.

11. ASTM C 1363 - Standard Test Method for Thermal Performance of Building Assemblies by Means of a Hot Box Apparatus.
12. ASTM C1199 - Standard Test Method for Measuring the Steady-State Thermal Transmittance of Fenestration Systems Using Hot Box Methods
13. ASTM E1423 - Practice for Determining Steady State Thermal Transmittance of Fenestration Systems.
14. ASTM E330 - Standard Test Method for Structural Performance of Exterior Windows, Curtain Walls, and Doors by Uniform Static Air Pressure Difference.
15. ASTM E1886 - Test Method for Performance of Exterior Windows, Curtain Walls, Doors and Shutters Impacted by Missiles and Exposed to Cyclic Pressure Differentials.
16. ASTM E1996 - Standard Specification for Performance of Exterior Windows, Curtain Walls, Doors and Storm Shutters Impacted by Windborne Debris in Hurricanes.
17. ANSI/BHMA A156.115 - Hardware Preparation in Steel Doors and Frames.
18. ANSI/SDI 122 - Installation and Troubleshooting Guide for Standard Steel Doors and Frames.
19. ANSI/NFPA 80 - Standard for Fire Doors and Fire Windows; National Fire Protection Association.
20. ANSI/NFPA 105: Standard for the Installation of Smoke Door Assemblies.
21. FEMA P-361 2015/2021 - Design and Construction Guidance for Community Safe Rooms.
22. ICC 500 - 2014/2020 ICC/NSSA Standard for the Design and Construction of Storm Shelters.
23. NFPA 252 - Standard Methods of Fire Tests of Door Assemblies; National Fire Protection Association.
24. UL 10C - Positive Pressure Fire Tests of Door Assemblies.
25. UL 1784 - Standard for Air Leakage Tests of Door Assemblies.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated. Include construction details, material descriptions, core descriptions, hardware reinforcements, profiles, anchors, fire-resistance rating, and finishes.

B. Maintenance manual must be provided for tornado/hurricane storm shelter impact protective systems.

C. Door hardware supplier is to furnish templates, template reference number and/or physical hardware to the steel door and frame supplier in order to prepare the doors and frames to receive the finish hardware items.

D. Shop Drawings: Include the following:

1. Elevations of each door design.
2. Details of doors, including vertical and horizontal edge details and metal thicknesses.
3. Frame details for each frame type, including dimensioned profiles and metal thicknesses.
4. Locations of reinforcement and preparations for hardware.
5. Details of anchorages, joints, field splices, and connections.
6. Details of accessories.
7. Details of moldings, removable stops, and glazing.
8. Details of conduit and preparations for power, signal, and control systems.

E. Samples for Verification:

1. Samples are only required by request of the architect and for manufacturers that are not current members of the Steel Door Institute.

F. Informational Submittals:

1. Hurricane Resistant Openings (State of Florida): Within the State of Florida, provide copy of current State of Florida Product Approval as proof of compliance that doors, frames and hardware for exterior

opening assemblies have been tested and approved for use at the design pressure level and debris impact resistance requirements specified for the Project.

a. Hurricane Resistant Components (State of Florida): Within the State of Florida, provide copy of independent, third-party certified listing conforming to ANSI A250.13.

1.4 QUALITY ASSURANCE

A. Source Limitations: Obtain hollow metal doors and frames through one source from a single manufacturer wherever possible.

B. Quality Standard: In addition to requirements specified, furnish SDI-Certified manufacturer products that comply with ANSI/SDI A250.8, latest edition, "Recommended Specifications for Standard Steel Doors and Frames".

C. Fire-Rated Door Assemblies: Assemblies complying with NFPA 80 that are listed and labeled by a qualified testing agency, for fire-protection ratings indicated, based on testing at positive pressure according to UL10C (neutral pressure at 40" above sill) or UL 10C.

1. Oversize Fire-Rated Door Assemblies Construction: For units exceeding sizes of tested assemblies, attach construction label certifying doors are built to standard construction requirements for tested and labeled fire rated door assemblies except for size.
2. Temperature-Rise Limit: Where indicated and at vertical exit enclosures (stairwell openings) and exit passageways, provide doors that have a maximum transmitted temperature end point of not more than 450 deg F (250 deg C) above ambient after 30 minutes of standard fire-test exposure.
3. Smoke Control Door Assemblies: Comply with NFPA 105.

a. Smoke "S" Label: Doors to bear "S" label, and include smoke and draft control gasketing applied to frame and on meeting stiles of pair doors.

D. Fire-Rated, Borrowed-Light Frame Assemblies: Assemblies complying with NFPA 80 that are listed and labeled, by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire-protection ratings indicated, based on testing according to NFPA 257. Provide labeled glazing material.

E. Hurricane Resistant Exterior Openings (State of Florida including High Velocity Hurricane Zone (HVHZ): Provide exterior hollow metal doors and frames as complete and tested assemblies, or component assemblies, including approved hardware specified under Section 087100 "Door Hardware", to meet the design pressures, debris impact resistance, and glass and glazing requirements as detailed in the current State of Florida building code sections applicable to the Project.

1. Each unit to bear third party permanent label in accordance with Florida Building Code requirements.

F. Storm Shelter Openings: Provide complete door systems for hurricane or tornado storm shelters, and other areas of refuge, complying and tested according to ICC 500 (2014/2020), ICC/NSSA Standard for the Design and Construction of Storm Shelters.

1. Each unit to bear third party permanent label indicating compliance with the referenced testing standards.

G. Pre-Submittal Conference: Conduct conference in compliance with requirements in Division 01 Section "Project Meetings" with attendance by representatives of Supplier, Installer, and Contractor to review

proper methods and procedures for installing hollow metal doors and frames and to verify installation of electrical knockout boxes and conduit at frames with electrified or access control hardware.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver hollow metal work palletized, wrapped, or crated to provide protection during transit and Project site storage. Do not use non-vented plastic.

B. Deliver welded frames with two removable spreader bars across bottom of frames, tack welded to jambs and mullions.

C. Store hollow metal work under cover at Project site. Place in stacks of five units maximum in a vertical position with heads up, spaced by blocking, on minimum 4-inch high wood blocking. Do not store in a manner that traps excess humidity.

1. Provide minimum 1/4-inch space between each stacked door to permit air circulation. Door and frames to be stacked in a vertical upright position.

1.6 PROJECT CONDITIONS

A. Field Measurements: Verify actual dimensions of openings by field measurements before fabrication.

1.7 COORDINATION

A. Coordinate installation of anchorages for hollow metal frames. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors. Deliver such items to Project site in time for installation.

B. Building Information Modeling (BIM) Support: Utilize designated BIM software tools and obtain training needed to successfully participate in the Project BIM processes. All technical disciplines are responsible for the product data integration and data reliability of their Work into the coordinated BIM applications.

1.8 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace doors that fail in materials or workmanship within specified warranty period.

B. Warranty includes installation and finishing that may be required due to repair or replacement of defective doors.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide steel doors and frames from a SDI Certified manufacturer:

1. CECO Door Products (C).
2. Curries Company (CU).

2.2 MATERIALS

A. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, Commercial Steel (CS), Type B; suitable for exposed applications.

B. Metallic-Coated Steel Sheet: ASTM A 653/A 653M, Commercial Steel (CS), Type B; with minimum G60 (Z180) or A60 (ZF180) metallic coating.

C. Frame Anchors: ASTM A 653/A 653M, Commercial Steel (CS), Commercial Steel (CS), Type B; with minimum G60 (Z180) or A60 (ZF180) metallic coating.

2.3 HOLLOW METAL DOORS

A. General: Provide 1-3/4 inch doors of design indicated, not less than thickness indicated; fabricated with smooth surfaces, without visible joints or seams on exposed faces unless otherwise indicated. Comply with ANSI/SDI A250.8 and ANSI/NAAMM HMMA 867.

B. Exterior Doors: Face sheets fabricated of commercial quality hot-dipped zinc coated steel that complies with ASTM A 653/A 653M, Coating Designation A60. Provide doors complying with requirements indicated below by referencing ANSI/SDI A250.8 for level and model and ANSI/SDI A250.4 for physical performance level:

1. Design: Flush panel.
2. Core Construction: Manufacturer’s thermally enhanced QMax core. Where indicated provide doors fabricated as thermal-rated assemblies with a minimum thermal rating of 0.35 BTU/hr-ft2-F.
3. Level/Model: Level 3 and Physical Performance Level A (Extra Heavy Duty), Minimum 16 gauge (0.053-inch - 1.3-mm) thick steel, Model 2.
4. Vertical Edges: Vertical edges to have the face sheets joined by a continuous weld extending the full height of the door. Welds are to be ground, filled and dressed smooth. Beveled Lock Edge, 1/8 inch in 2 inches (3 mm in 50 mm).
5. Top and Bottom Edges: Reinforce tops and bottoms of doors with a continuous steel channel not less than 16 gauge, extending the full width of the door and welded to the face sheet. Doors with an inverted top channel to include a steel closure channel, screw attached, with the web of the channel flush with the face sheets of the door. Plastic or composite channel fillers are not acceptable.
6. Hinge Reinforcement: Minimum 7 gauge (3/16") plate 1-1/4" x 9" or minimum 14 gauge continuous channel with pierced holes, drilled and tapped.
7. Hardware Reinforcements: Fabricate according to ANSI/SDI A250.6 with reinforcing plates from same material as door face sheets.

C. Interior Doors: Face sheets fabricated of commercial quality cold rolled steel that complies with ASTM A 1008/A 1008M. Provide doors complying with requirements indicated below by referencing ANSI/SDI A250.8 for level and model and ANSI/SDI A250.4 for physical performance level:

1. Design: Flush panel.
2. Core Construction: Manufacturer's standard kraft-paper honeycomb, or one-piece polystyrene core, securely bonded to both faces.

    a. Fire Door Core: As required to provide fire-protection and temperature-rise ratings indicated.

3. Level/Model: Level 2 and Physical Performance Level B (Heavy Duty), Minimum 18 gauge (0.042-inch - 1.0-mm) thick steel, Model 2.

4. Vertical Edges: Vertical edges to have the face sheets spot welded and filled full height with an epoxy filler. Welds are to be ground, filled and dressed smooth. Beveled Lock Edge, 1/8 inch in 2 inches (3 mm in 50 mm).
5. Top and Bottom Edges: Reinforce tops and bottoms of doors with a continuous steel channel not less than 16 gauge, extending the full width of the door and welded to the face sheet.
6. Hinge Reinforcement: Minimum 7 gauge (3/16") plate 1-1/4" x 9" or minimum 14 gauge continuous channel with pierced holes, drilled and tapped.
7. Hardware Reinforcements: Fabricate according to ANSI/SDI A250.6 with reinforcing plates from same material as door face sheets.

D. Manufacturers Basis of Design:

1. Curries Company (CU) - QMax Core - 707 Series.

2.4 HOLLOW METAL DOOR AND SHUTTER ASSEMBLIES FOR STORM SHELTERS **N.A.**

2.5 HOLLOW METAL FRAMES

A. General: Comply with ANSI/SDI A250.8 and with details indicated for type and profile.

B. Exterior Frames: Fabricated of hot-dipped zinc coated steel that complies with ASTM A 653/A 653M, Coating Designation A60.

1. Fabricate frames with mitered or coped corners. Profile as indicated on drawings.
2. Manufacturers Basis of Design:

a. Curries Company (CU) - M CM G CG Series.

C. Interior Frames: Fabricated from cold-rolled steel sheet that complies with ASTM A 1008/A 1008M.

1. Fabricate frames with mitered or coped corners. Profile as indicated on drawings.
2. Manufacturers Basis of Design:

a. Curries Company (CU) - M Series.

D. Fire rated frames: Fabricate frames in accordance with NFPA 80, listed and labeled by a qualified testing agency, for fire-protection ratings indicated.

E. Hardware Reinforcement: Fabricate according to ANSI/SDI A250.6 Table 4 with reinforcement plates from same material as frames.

2.6 FRAMES FOR STORM SHELTERS **N.A.**

2.7 FRAME ANCHORS

A. Jamb Anchors:

1. Masonry Type: Adjustable strap-and-stirrup or T-shaped anchors to suit frame size, formed from A60 metallic coated material, not less than 0.042 inch thick, with corrugated or perforated straps not less than 2 inches wide by 10 inches long; or wire anchors not less than 0.177 inch thick.

2. Stud Wall Type: Designed to engage stud and not less than 0.042 inch thick.
3. Compression Type for Drywall Slip-on (Knock-Down) Frames: Adjustable compression anchors.

B. Floor Anchors: Floor anchors to be provided at each jamb, formed from A60 metallic coated material, not less than 0.042 inches thick.

C. Mortar Guards: Formed from same material as frames, not less than 0.016 inches thick.

2.8 LOUVERS

A. Metal Louvers: Unless otherwise indicated provide louvers to meet the following requirements.

1. Blade Type: Vision proof inverted V or inverted Y.
2. Metal and Finish: Galvanized steel, 0.040 inch thick, factory primed for paint finish with baked enamel or powder coated finish. Match pre-finished door paint color where applicable.

B. Louvers for Fire Rated Doors: Metal louvers with fusible link and closing device, listed and labeled for use in doors with fire protection rating of 1-1/2 hours and less.

1. Manufacturers: Subject to compliance with requirements, provide louvers to meet rating indicated.
2. Metal and Finish: Galvanized steel, 0.040 inch thick, factory primed for paint finish with baked enamel or powder coated finish. Match pre-finished door paint color where applicable.

2.9 LIGHT OPENINGS AND GLAZING

A. Stops and Moldings: Provide stops and moldings around glazed lites where indicated. Form corners of stops and moldings with butted or mitered hairline joints at fabricator’s shop. Fixed and removable stops to allow multiple glazed lites each to be removed independently. Coordinate frame rabbet widths between fixed and removable stops with the type of glazing and installation indicated.

B. Moldings for Glazed Lites in Doors and Loose Stops for Glazed Lites in Frames: Minimum 20 gauge thick, fabricated from same material as door face sheet in which they are installed.

C. Fixed Frame Moldings: Formed integral with hollow metal frames, a minimum of 5/8 inch (16 mm) high unless otherwise indicated. Provide fixed frame moldings and stops on outside of exterior and on secure side of interior doors and frames.

D. Preformed Metal Frames for Light Openings: Manufacturer's standard frame formed of 0.048-inch-thick, cold rolled steel sheet; with baked enamel or powder coated finish; and approved for use in doors of fire protection rating indicated. Match pre-finished door paint color where applicable.

2.10 ACCESSORIES

A. Mullions and Transom Bars: Join to adjacent members by welding or rigid mechanical anchors.

B. Grout Guards: Formed from same material as frames, not less than 0.016 inches thick.

2.11 FABRICATION

A. Fabricate hollow metal work to be rigid and free of defects, warp, or buckle. Accurately form metal to required sizes and profiles, with minimum radius for thickness of metal. Where practical, fit and assemble

units in manufacturer's plant. When shipping limitations so dictate, frames for large openings are to be fabricated in sections for splicing or splining in the field by others.

B. Tolerances: Fabricate hollow metal work to tolerances indicated in ANSI/SDI A250.8.

C. Hollow Metal Doors:

1. Exterior Doors: Provide optional weep-hole openings in bottom of exterior doors to permit moisture to escape where specified.
2. Glazed Lites: Factory cut openings in doors with applied trim or kits to fit. Factory install glazing where indicated.
3. Astragals: Provide overlapping astragals as noted in door hardware sets in Division 08 Section "Door Hardware" on one leaf of pairs of doors where required by NFPA 80 for fire-performance rating or where indicated. Extend minimum 3/4 inch beyond edge of door on which astragal is mounted.
4. Continuous Hinge Reinforcement: Provide welded continuous 12 gauge strap for continuous hinges specified in hardware sets in Division 08 Section "Door Hardware".

D. Hollow Metal Frames:

1. Shipping Limitations: Where frames are fabricated in sections due to shipping or handling limitations, provide alignment plates or angles at each joint, fabricated of same thickness metal as frames.
2. Welded Frames: Weld flush face joints continuously; grind, fill, dress, and make smooth, flush, and invisible.

    a. Welded frames are to be provided with two steel spreaders temporarily attached to the bottom of both jambs to serve as a brace during shipping and handling. Spreader bars are for bracing only and are not to be used to size the frame opening.

3. Sidelight and Transom Bar Frames: Provide closed tubular members with no visible face seams or joints, fabricated from same material as door frame. Fasten members at crossings and to jambs by butt welding.
4. High Frequency Hinge Reinforcement: Provide high frequency hinge reinforcements at door openings 48-inches and wider with mortise butt type hinges at top hinge locations.
5. Continuous Hinge Reinforcement: Provide welded continuous 12 gauge straps for continuous hinges specified in hardware sets in Division 08 Section "Door Hardware".
6. Provide countersunk, flat- or oval-head exposed screws and bolts for exposed fasteners unless otherwise indicated for removable stops, provide security screws at exterior locations.
7. Mortar Guards: Provide guard boxes at back of hardware mortises in frames at all hinges and strike preps regardless of grouting requirements.
8. Floor Anchors: Weld anchors to bottom of jambs and mullions with at least four spot welds per anchor.
9. Jamb Anchors: Provide number and spacing of anchors as follows:

    a. Masonry Type: Locate anchors not more than 18 inches from top and bottom of frame. Space anchors not more than 32 inches on-center and as follows:

        1) Two anchors per jamb up to 60 inches high.
        2) Three anchors per jamb from 60 to 90 inches high.
        3) Four anchors per jamb from 90 to 120 inches high.
        4) Four anchors per jamb plus 1 additional anchor per jamb for each 24 inches or fraction thereof above 120 inches high.

b. Stud Wall Type: Locate anchors not more than 18 inches from top and bottom of frame. Space anchors not more than 32 inches o.c. and as follows:

1) Three anchors per jamb up to 60 inches high.
2) Four anchors per jamb from 60 to 90 inches high.
3) Five anchors per jamb from 90 to 96 inches high.
4) Five anchors per jamb plus 1 additional anchor per jamb for each 24 inches or fraction thereof above 96 inches high.
5) Two anchors per head for frames above 42 inches wide and mounted in metal stud partitions.

10. Door Silencers: Except on weatherstripped or gasketed doors, drill stops to receive door silencers. Silencers to be supplied by frame manufacturer regardless if specified in Division 08 Section "Door Hardware".
11. Bituminous Coating: Where frames are fully grouted with an approved Portland Cement based grout or mortar, coat inside of frame throat with a water based bituminous or asphaltic emulsion coating to a minimum thickness of 3 mils DFT, tested in accordance with UL 10C and applied to the frame under a 3rd party independent follow-up service procedure.

E. Hardware Preparation: Factory prepare hollow metal work to receive template mortised hardware; include cutouts, reinforcement, mortising, drilling, and tapping according to the Door Hardware Schedule and templates furnished as specified in Division 08 Section "Door Hardware."

1. Locate hardware as indicated, or if not indicated, according to ANSI/SDI A250.8.
2. Reinforce doors and frames to receive non-template, mortised and surface mounted door hardware.
3. Comply with applicable requirements in ANSI/SDI A250.6 and ANSI/DHI A115 Series specifications for preparation of hollow metal work for hardware.
4. Coordinate locations of conduit and wiring boxes for electrical connections with Division 26 Sections.

2.12 STEEL FINISHES

A. Prime Finishes: Doors and frames to be cleaned, and chemically treated to insure maximum finish paint adhesion. Surfaces of the door and frame exposed to view to receive a factory applied coat of rust inhibiting shop primer.

1. Shop Primer: Manufacturer's standard, fast-curing, lead and chromate free primer complying with ANSI/SDI A250.10 acceptance criteria; recommended by primer manufacturer for substrate; and compatible with substrate and field-applied coatings.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. General Contractor to verify the accuracy of dimensions given to the steel door and frame manufacturer for existing openings or existing frames (strike height, hinge spacing, hinge back set, etc.).

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Remove welded in shipping spreaders installed at factory. Restore exposed finish by grinding, filling, and dressing, as required to make repaired area smooth, flush, and invisible on exposed faces.

B. Prior to installation, adjust and securely brace welded hollow metal frames for square, level, twist, and plumb condition.

C. Tolerances shall comply with SDI-117 "Manufacturing Tolerances Standard Steel Doors and Frames."

D. Drill and tap doors and frames to receive non-template, mortised, and surface-mounted door hardware.

E. Verify tolerances against manufacturers installations instructions for tornado and hurricane storm shelter openings.

3.3 INSTALLATION

A. General: Install hollow metal work plumb, rigid, properly aligned, and securely fastened in place; comply with Drawings and manufacturer's written instructions.

B. Hollow Metal Frames: Install hollow metal frames of size and profile indicated. Comply with ANSI/SDI A250.11 and NFPA 80 at fire rated openings.

1. Set frames accurately in position, plumbed, leveled, aligned, and braced securely until permanent anchors are set. After wall construction is complete and frames properly set and secured, remove temporary braces, leaving surfaces smooth and undamaged. Shim as necessary to comply with installation tolerances.
2. Floor Anchors: Provide floor anchors for each jamb and mullion that extends to floor, and secure with post-installed expansion anchors.
3. Masonry Walls: Coordinate installation of frames to allow for solidly filling space between frames and masonry with mortar.
4. Grout Requirements: Do not grout head of frames unless reinforcing has been installed in head of frame. Do not grout vertical or horizontal closed mullion members.

C. Hollow Metal Doors: Fit hollow metal doors accurately in frames, within clearances specified below. Shim as necessary.

1. Non-Fire-Rated Standard Steel Doors:

    a. Jambs and Head: 1/8 inch plus or minus 1/16 inch.
    b. Between Edges of Pairs of Doors: 1/8 inch plus or minus 1/16 inch.
    c. Between Bottom of Door and Top of Threshold: Maximum 3/8 inch.
    d. Between Bottom of Door and Top of Finish Floor (No Threshold): Maximum 3/4 inch.

2. Fire-Rated Doors: Install doors with clearances according to NFPA 80.

D. Field Glazing: Comply with installation requirements in Division 08 Section "Glazing" and with hollow metal manufacturer's written instructions.

3.4 ADJUSTING AND CLEANING

A. Final Adjustments: Check and readjust operating hardware items immediately before final inspection. Leave work in complete and proper operating condition. Remove and replace defective work, including hollow metal work that is warped, bowed, or otherwise unacceptable.

B. Remove grout and other bonding material from hollow metal work immediately after installation.

C. Prime-Coat and Painted Finish Touchup: Immediately after erection, sand smooth rusted or damaged areas of prime coat, or painted finishes, and apply touchup of compatible air drying, rust-inhibitive primer, zinc rich primer (exterior and galvanized openings) or finish paint.

3.5 FIELD QUALITY CONTROL

A. Field Inspection (Punch Report): Reference Division 01 Sections “Closeout Procedures”. Produce project punch report for each installed door opening indicating compliance with approved submittals and verification hardware is properly installed, operating and adjusted. Include list of items to be completed and corrected, indicating the reasons or deficiencies causing the Work to be incomplete or rejected.

1. Organization of List: Include separate Door Opening and Deficiencies and Corrective Action Lists organized by Mark, Opening Remarks and Comments, and related Opening Images and Video Recordings.

END OF SECTION

SECTION 9D

ACOUSTICAL TREATMENT

9D-01. GENERAL CONDITIONS:

The General and Special Conditions, Division II, Sections E and F of these specifications shall apply to and form a part of this Section as if written in full herein.

9D-02. SCOPE:

The work to be done under this heading includes the furnishing of all labor, equipment, services, and materials necessary for, or reasonably incidental to, making a complete installation of the suspended acoustical tile ceilings in strict accordance with these specifications and/or as indicated on the drawings. No deviation from these specifications shall be allowed unless approved by the Architect in writing prior to bid date. All acoustical materials and suspension systems shall be installed by a subcontractor thoroughly experienced in this type of work and approved by the manufacturer. **It shall be the responsibility of the acoustical contractor to provide adequate support for the light fixtures and it shall be this contractor's responsibility to coordinate his work with the electrical and mechanical contractors. This contractor is to arrange for adequate anchorage to the frame system.**

9D-03. NON-BEVELED EDGE SUSPENDED GRID LAY IN TILE CEILING SYSTEM:

A. Grid System: Shall be Prelude XL 15/16" suspended exposed tee grid as manufactured by Armstrong World Industries, Inc.

1. Components: All main beams and cross tees shall be commercial - quality hot dipped galvanized steel. Exposed surfaces chemically cleansed, capping prefinished in baked polyester pain. Main beams and cross tees are double-web steel construction with 15/16" type exposed flange design column strength and staked-on end detail allowing easy cross tee removal and remounting. Main beams shall be 1 ½" spaced not more than 4'0" o.c. Cross tees shall be 1 ½". Wall molding shall be #7800 with ½ " exposed flange. Hanger wire shall be 12-gauge galvanized carbon steel.

2. Finish: All steel roll-formed parts, including cap, shall be chemically cleansed. Capping shall be prefinished in a baked polyester paint finish. Color shall be WHITE and match the actual color of the selected ceiling tile, unless other specified. Off white not acceptable.

B. Ceiling Lay-in Tile Units:

1 Lay-in tile units shall be Armstrong Mineral Fiber Ceiling Tile Units, Georgian #764 Pattern with and exposed grid system, Humiguard Plus, 24" x 24" x ⅝". Tile units shall be Class “A”. Have a light reflectance of LR-1 (over 75%), and N.R.C. range of .50-.60, and an STC range of 35-29.

9D-04. BEVELED EDGE SUSPENDED GRID LAY IN TILE CEILING SYSTEM:

N.A.

9D-05. KITCHEN ZONE, SUSPENDED GRID LAY IN TILE CEILING SYSTEM:

A. Grid System: Shall be Prelude XL 15/16" suspended exposed tee grid as manufactured by Armstrong World Industries, Inc.

1. Components: All main beams and cross tees shall be commercial - quality hot dipped galvanized steel. Exposed surfaces chemically cleansed, capping prefinished in baked polyester pain. Main beams and cross tees are double-web steel construction with 15/16" type exposed flange design column strength and staked-on end detail allowing easy cross tee removal and remounting. Main beams shall be 1 ½" spaced not more than 4'0" o.c. Cross tees shall be 1 ½". Wall molding shall be #7800 with ⅞" exposed flange. Hanger wire shall be 12-gauge galvanized carbon steel.

2. Finish: All steel roll-formed parts, including cap, shall be chemically cleansed. Capping shall be prefinished in a baked polyester paint finish. Color shall be WHITE and match the actual color of the selected ceiling tile, unless other specified. Off white not acceptable.

B. Ceiling Lay-in Tile Units:

1 Lay-in tile units shall be Armstrong Kitchen Zone, Smooth Texture Square Lay-in Tile #673, 24" x 24" x _" with the following characteristics:

Acoustical Performance	CAC Rating 33
Fire Rating	Class A
Light Reflectance	0.89
Anti-Mold & Mildew	Bio-Block High Level of Performance
Sag Resistance	Humi Guard High level of Performance
VOC Emissions	Certified Low Level
Durability	Water Repel. Scratch Resistant, Soil Buildup Resistant, & Washable
Warranty	30 years

9D-06. ACOUSTICAL CEILING TILE TRIM: N.A.

9D-07. INSTALLATION AND COORDINATION:

Main "T" runners shall be of not more than 48" centers and supported by 12-gauge wire to joist or structural system members (no hanging from ducts, piping, etc.); use unistrut members where required. Each corner of light fixture shall also be supported by hanger wires. "T" spline intersecting moldings shall be locked in place. All runners and splines shall be straight or in alignment and flush at intersections. **Edge molding shall be mitered at all corners, internal and external.**

Exterior doors shall be hung and all doors and windows glazed and all wet work completely dry

before starting this work. Areas shall be broom clean before proceeding with this work.

The contractor shall extend complete coordination to and with the mechanical and electrical contractors in coordination of the work. Tile shall be centered one room and lighting fixtures, and ceiling grilles shall be centered in tiles. A reflected ceiling plan is included in the architectural drawings and it is the responsibility of the ceiling sub- contractor to verify their accuracy and to bring to the Architect's attention any areas that will create shifting of grid or mechanical or electrical items.

9D-08. EXTRA TILE:

The Ceiling Contractor shall upon completion of the work, leave a replacement supply of 400 SF of each type of tile. Extra tile is in addition to any tile used for replacing damaged or marred tile caused during construction or designated to replace from the Final Inspection.

9D-09. ACOUSTICAL WALL PANELS: **N.A.**

9D-10. ACOUSTICAL BARREL DIFFUSERS N.A.

9D-11. CLEAN-UP:

The Contractor shall remove all debris, scrap, etc., from the site upon completion of his work. Tile shall be free of finger prints, smudges, and present a uniform color, clean and level. Any tile found to contain smudges, chips, etc., shall be removed and replaced with new tile.

9D-12. GUARANTEE:

This contractor shall guarantee in writing the materials and workmanship for a period of two (2) years after final acceptance of the building.

END OF SECTION.

SECTION 9G

EXTERIOR INSULATION FINISH SYSTEM (E.I.F.S.)

9C-01. GENERAL AND SPECIAL CONDITIONS:

The General and Special Conditions, Division II, Sections E and F of these specifications shall apply to and form a part of this Section as if written in full herein.

9C-02. SCOPE:

The Contractor shall furnish all labor, materials, and equipment to complete the installation of the synthetic exterior insulation finish system as shown on the drawings and as specified in these specifications.

9C-03. QUALIFICATIONS:

Application shall be by qualified subcontractor and shall be able to present evidence of past projects using material submitted with name of project, date, location, and General Contractor name and phone number.

9C-04. MATERIALS:

A. General: Specifications are written around Sto Industries Incorporated Specifications. The Architect will consider substitutions for brand names of equal products. **Procedures for substituting shall be as per specifications, Instructions to Bidders, Paragraph B-5.**

B. System: Shall be Sto. System One Specification A-9C0 for application over stud wall construction and Specification A-200 for installation over concrete block walls. Equal systems by Senergy (Senerflex System) and / or Finestone are acceptable. All others are to be treated as above for substitutions.

C. Surface Preparation:

Sto Grundex - a deep penetrating, solvent-based substrate hardener and sealer, as manufactured by STO Industries, Inc.

Sto Plex - a solvent-based surface sealer and adhesion intermediary, as manufactured by STO Industries, Inc.

D. Adhesive:

1. STO ADH - a copolymer-based adhesive and leveler as manufactured by STO Industries, Inc., mixed 1:1 with Type 1 Portland Cement.

2. STO BTS-A (Alternate Adhesive) - a copolymer-based adhesive as manufactured by STO Industries, Inc., mixed with 20% by weight of Type 1

Portland Cement. Use where maximum flexibility is required. Because of its low cement content, interaction is minimized and flexibility maximized.

3. STO BTS-B - a polymer-based ground coat and leveler when mixed with 7-9C quarts of clean water.

4. Where applied on stud wall construction - STO DISPERSION ADHESIVE -a non-cementitious, ready-mixed 9C0% acrylic copolymer emulsion-based adhesive that is waterproof and vapor permeable, as manufactured by STO Industries, Inc.

E. Insulation Board: Expanded Polystyrene (EPS Board) less than 25 flame spread, 1.0 lbs./cu. ft. average density; U=0.26 per inch; ASTM C578-85 Class A. Thickness shall be generally 1" as shown or 1½" or greater where shown. Maximum size of EPS shall not exceed 2' x 4', board shall be manufactured by licensed EPS molder and each board shall bear identification mark. Insulation board shall be grooved on the backside to allow water to drain.

F. E.I.F. System Sheathing: Shall be ½" DENS-Glas Gold sheetrock backing manufactured by Georgia Pacific.

G. Ground Coat:

1. STO RFP - a ready-mixed, noncementitious, 9C0% acrylic copolymer emulsion-based, water resistant, vapor permeable, glass fiber reinforced non-capillary action ground coat. Tint same shade as finish.

2. STO BTS-A - a copolymer-based ground coat and leveler when mixed with 20% Type 1 Portland Cement by weight. Prior to application of any STO finish over STO BTS-A, STO PRIMER shall be applied as an adhesion intermediary providing water resistance. Tint to the same shade as finish.

3. STO BTS-B - a polymer-based ground coat and leveler.

H. Fabric:

1. On all surfaces **6 Ft above finish floor level and above**, fabric shall be STO REINFORCING FIBER MESH, with symmetrical interlaced glass fiber made from twisted multi-end strands, styrene butadiene coated at least 20 grams per square yard to provide a shift proof and alkaline resistant mesh compatible with STO materials.

2. On all surfaces **6 FT above finish floor level and below**, fabric shall be STO ARMOR MAT, heavy duty, double strand, interwoven glass fiber mesh specifically coated for compatibility with STO materials.

I. Finish: Shall be STO EXTERIOR STOLIT .75 ready-mixed acrylic based wall coating. Architect shall select type, colors, and aggregate size.

9C-05. INSTALLATION:

A. Installations shall be performed by and/or supervised by Certified Applicators.

Under no circumstances shall any of the products be altered by adding any additives,

except for small amounts of clean water as directed on label; or when using STO PLEX. Antifreeze, accelerators, rapid binders, etc., are not acceptable.

B. The surface to receive the Full Thermal System shall be structurally sound, clean, dry, and uniform. If the surface of the wood sheathing has weathered or the factory applied seal on gyp sheathing has been exposed longer than the gyp sheathing manufacturer's recommendations, then prime the entire surface with STO PLEX.

For masonry application:

- For leveling of irregularities, STO, ADH, STO BTS-A or STO BTS-B shall be used. For excessive amounts of leveling, use a 2:1:6 Portland: lime/sand mixture.
- For sanded surfaces of old plaster, masonry and concrete, seal surface with STO GRUNDEX.
- For efflorescence, remove with a diluted acid wash or appropriate means.
- Form release agents and other residue must be removed by appropriate means.

C. A starter strip of STO REINFORCING FIBER MESH shall be applied to the wall at the base line using STO ADH, STO BTS-A or STO BTS-B prior to installation of the EPS Board. It shall be wide enough to adhere 4" of mesh onto the wall, be able to wrap around the board edge and cover approximately 4" on the outside surface of the EPS Board. This procedure shall be followed at all exposed EPS Board edges as per STO details (example - window and door heads and jambs).

Use STO DISPERSION ADHESIVE on stud wall application.

D. Masonry: Use STO ADH to adhere EPS Boards to substrate. Mix STO ADH, STO BTS-A or STO BTS-B according to manufacturer's recommendations. Apply the adhesive to the back of the EPS Boards using a ½ " notched trowel Ribbons of adhesive shall be uniform and run horizontal with the building walls.

Stud Wall Application: Apply STO DISPERSION ADHESIVE to the back of the EPS Boards using a 3/16" u-notched trowel. Ribbons of adhesive should be uniform and run horizontal with the building walls.

E. The EPS Boards shall be placed horizontally on the walls starting from a level base line. Stagger vertical joints and interlock EPS Boards at all inside and outside corners. Apply firm pressure over entire surface of the boards to insure uniform contact. Sufficient pressure shall be applied to flatten the ribbons of adhesive to result in a minimum of 50% adhesion. All joints shall be butted tightly together to eliminate any thermal breaks in the STO Full Thermal System. Keep any adhesive from getting between the joints of the EPS Boards. Adhesive shall have adequate curing time before any further work can be done over the EPS Boards. All open joints in the EPS Board layer shall be filled with slivers of EPS Board or an approved spray foam.

The use of nails, screws, or any other type of non-thermal mechanical fasteners is not acceptable.
Rasping of the EPS Board surface shall be required to achieve a smooth, even surface and remove possible ultraviolet ray damage.

Use of plastic or metal corner beads, stop beads, etc., will not be acceptable.

F. **All areas where the Full Thermal System meets dissimilar material or terminates**

shall have the EPS Boards cut back from the adjoining material a minimum of ¼" to form a caulk joint and sealed (caulked) so that no water can penetrate through or behind the system. Prior to sealing (caulking), all EPS Boards edges shall be coated with STO RFP, STO BTS-A or STO BTS-B and STO PRIMER. Application to be allowed to dry before sealing (caulking).

G. Mixing and preparation of finish material shall be in strict accordance to manufacturer's directions. Apply a ground coat of STO RFP over EPS Board using proper spray equipment or a stainless-steel trowel to a uniform thickness of approximately 1/16". Work horizontally or vertically in strips of 40 inches, and immediately embed the STO REINFORCING FIBER MESH into the wet ground coat.

STO REINFORCING FIBER MESH shall be double wrapped at all corners and overlapped not less than 2½" at mesh joints. Avoid wrinkles in the mesh. The finish thickness of the ground coat shall be such that the STO REINFORCING FIBER MESH is fully imbedded. Allow ground coat to thoroughly dry before applying finish.

H. Caulking: Install backer rod (25% compression) in caulk joint openings to provide a depth equal to the width of the joint. Install a STO approved caulk and tool flush with the ground coat surface. Allow caulk to set per manufacturer's specifications prior to applying the STO finish coat. **(See Paragraph "F" above)**

Caulking shall be in strict conformance to the manufacturer's details and shall be installed at all places where the EIFS abuts a dissimilar material. Caulking shall be installed to make for a neat and professional job.

I. The STO finish, a ready-mixed acrylic-based wall coating shall be applied directly over the STO RFP ground coat or over primed STO BTS-A or STO BTS-B ground coat ONLY AFTER THE GROUND COAT HAS THOROUGHLY DRIED. Finish shall be applied by spraying, rolling, or troweling using a stainless-steel trowel.

9C-06. SOFFIT VENTS: **N.A.**

9C-07 SUBMITTAL:

Contractor shall submit shop drawings which will include specifications noting type of materials to be used, manufacturer's details, and color charts for color selection. Colors will be selected from the manufacturer's standard color chart. Along with color chart contractor shall submit an 8"x 9C" sample of finish and color.

9C-08. WARRANTY:

Manufacturer's warranty shall be furnished guaranteeing in writing that the materials are free from defects and the workmanship for a period of five (5) years.

9C-09. CLEANING:

The Contractor shall be responsible for cleaning all surfaces of excess finish material and removal of all equipment and unused material and debris from his operation from the site.

END OF SECTION.

SECTION 10A

MISCELLANEOUS SPECIALTIES

10A-01. GENERAL CONDITIONS:

The General Conditions, Division II, Sections E and F of these specifications shall apply to and form a part of this Section as if written in full herein.

10A-02. SCOPE:

Work under this heading includes necessary labor and materials required to install items listed in this Section or shown on the contract drawings.

10A-03. ACCESS PANELS AND DOORS:

Access panels for access to mechanical or electrical items shall be furnished to the general contractor by the respective subcontractor and installation shall be by the General Contractor.

All other areas which require access, access panels shall be furnished and installed by the General Contractor. Doors shall be suitable for wall or ceiling finish involved. Opening size shall be as required or as indicated and fire rated where rated walls or ceilings are penetrated. Units shall be equal to those manufactured by Milcor, Philip Carey, Zurn, or other approved equal.

10A-04. PAIRED OPERABLE PARTITION: **N.A.**

10A-05. ALUMINUM LETTERS: **As shown on drawings**

10A-06. ALUMINUM PLAQUE: **N.A.**

10A-07. ALUMINUM SHIPS LADDER: N.A.

10A-07. ALUMINUM THRESHOLDS:

See Finish Hardware Section, these specifications. All thresholds to be set in full bed of mastic.

10A-08. ALUMINUM & STEEL MISCELLANEOUS SHAPES:

Furnish and install all aluminum or steel angles, channels, break metal shapes, in sizes and shapes and at locations as shown on drawings, or as required for support, bracing, anchoring, etc. of incidental items whether shown or not.

10A-09. BATHROOM ACCESSORIES:

Furnish and install the following accessories in locations as stated. Exact locations will be as directed by Architect.

A. Accessories:

1. Surface Mounted Paper Towel Dispenser: To be Bobrick Model #B262 Commercial stainless steel, surface-mounted towel dispenser. Quantity required: four (4).

2. Mirrors: Bobrick Model #165-2430 satin finish stainless steel frame. All welded construction. 18-gauge wall hanger and theft-resistant mounting bracket. 24" x 30" or sizes as shown on the interior elevations and drawings. Quantity required: four (4).

NOTE: Where shown full length and height, contractor to verify dimensions required with a mirror supplier

3. Toilet Tissue Holder: Bobrick Model #B-2888 Commercial, surface-mounted toilet paper dispenser, stainless steel with satin finish. Quantity required: fifteen (15).

4. Grab Bars: Bradley 1 ½" O.D., S.S. Series 812, sanitary safe grey finish 059 configuration and 001 configuration grab bar installation for concealed mounting. Quantity required: Three (3).

5. Mop Holder: N.A.

6. Baby Diaper Changing Station: **N.A.**

7. Electric Hand Dryers: N.A.

10A-10. CHAIN LINK FENCE: See the Civil drawings and specifications.

10A-11. FIRE EXTINGUISHERS:

Furnish and install eight (8) 10 lb. capacity fire extinguishers equal to "J L Industries Cosmic 10E A B C with U.L. rating 4A-60BC and install at location as directed by Owner/Architect.

Provide complete with metal hanger. Exact location will be as directed by Architect. Mounting height to be so top of extinguisher not more than 5'-0" A.F.F. Prior to final inspection each extinguisher shall be inspected by the local fire inspector and tagged with inspection sticker showing unit fully charged, date and signature of inspector.

10A-12. HANDRAILS/ GUARDRAILS: N.A.

10A-13. HAT CHANNELS:

Furnish and install 1 ½" and ¾" galvanized hat channels for framing and installation of metal fascia and medal siding panels as shown and noted on the drawings. Light gauge framing for installation of fascia system shall be as shown on the drawings and specified in Section 11 of these specifications.

10A-14. MARKER BOARDS AND TACK BOARDS: N.A.

10A-15. MOP HOLDERS: N.A.

10A-16. PRECAST CONCRETE SILLS / WALL CAPS: N.A.

10A-17. SIGNAGE: **N.A.**

10A-18. SOLID PLASTIC TOILET PARTITIONS:

Furnish and install solid plastic partitions for toilet, urinal, and handicapped compartments, where shown and noted on the drawings.

A. Materials:

1. Toilet partitions, **and urinal screens** shall be floor mounted, overhead braced, with non-corrosive panels and pilaster similar and equal to Poly-Mar HD partitions as manufactured by Santana Products Company, Inc. Scranton, PA or comparable products with hardware as specified herein.

2. Panels, doors and pilasters shall be fabricated from Polymer resins under high pressure forming a single component section which is waterproof, non-absorbent and has a self-lubricating surface that resists marking with pens, pencils, or other writing utensils. All panels, doors and pilasters to arrive at job site with special protective plastic covering.

B. Construction:

1. Single component construction of solid Poly-Mar HD in colors that extend from the surface throughout the entire thickness of the panels, doors and pilasters.

2. Doors panels, pilasters and seats shall be 1" thick and all edges machined to a radius of .250" and all exposed surfaces to be free of saw marks.

3. Divider panels shall be 55" high and mounted at 14" above finished floor.

4. Doors shall be 55" high mounted at 14" above finished floor. Aluminum edging strips shall be fastened to the bottom edge of all doors full width.

5. Pilasters shall be 82" high and fastened to 3" high, 20 gauge stainless steel shoes with theft proof sex bolts.

6. Colors to be selected from the manufacturer's standard colors, Series 1000

colors.

C. Hardware:

1. Door hardware shall be as follows:

   a. Hinges shall be fabricated from heavy aluminum extrusion (6063-T6 allow) with bright dip anodized finish with wrap around flanges, surface mounted and thru-bolted to doors and pilasters with one way sex bolts. Hinges will be factory set in a full close position unless otherwise noted. **Doors with piano hinges are not acceptable.**

   b. Each door shall be furnished with two (2) coat hook/bumper of heavy chrome plated zamac with rubber bumper. One (1) door pull and one (1) wall stop.

   c. Door strike and keeper shall be fabricated from heavy aluminum extrusion (6063-T6 alloy) with bright dip anodized finish with wrap around flange surface mounted and thru-bolted to pilaster with one way sex bolts.

   d. Door latch housing shall be fabricated from heavy duty aluminum extrusion (6063-T6 alloy) with bright dip anodized finish, surface mounted and thru-bolted to door with one way sex bolts. Side bolt and button shall be heavy aluminum with “Tough-Coat Black” finish.

2. Pilaster shoes shall be anchored to finish floor with No. 5 plastic anchors and No. 14 stainless steel Phillips head screws.

3. Full-length continuous wall brackets (6063-T6 allow) with bright dip finish weighing not less than 1.685 lbs. Per linear foot shall be used for all panels to pilaster, pilaster to wall, and panel to wall connections. Wall brackets shall be thru bolted to panels and pilasters with one way sex bolts. Attachment of brackets to adjacent wall construction shall be accomplished by one (1) theft-proof Zamac mushroom nail in head anchor directly behind the vertical edge of panels and pilasters at every 12" along the full length of bracket and two (2) No. 5 plastic anchors and No. 14 X 1 ¼" stainless steel Phillips head screws at every 12" intervals alternately spaced between anchor connections.

4. Head rail shall be heavy aluminum extrusion (6063-T6 alloy) with a bright dip finish in anti-grip configuration weighing not less than 1.19 lbs. per linear foot. Headrails shall be fastened to the tops of pilasters and head rail brackets by thru-bolting with one-way sex bolts.

5. Head rail bracket shall be of 16-gauge stainless steel.

D. Installation: Erection of partitions shall be in accordance with the manufacturer’s standard recommendations and the following.

1. All parts shall be erected in a substantial manner, straight, level, and plumb.

2. No evidence of drilling, cutting, or patching shall be visible in the finished work.

3. Clearance at vertical edges of doors shall be uniform top to bottom and shall not exceed ¼".

4. **Warped or damaged panels will be rejected.**

5. Finished surfaces shall be cleaned after installation and left free of imperfections.

E. Furnish shop drawings **and a sample of hardware** for Architect's approval. Furnish color samples from actual material for color selection. Color selection will be from Series 1000 colors.

10A-19. LAUNDRY, KITCHEN, AND BAR EQUIPMENT:

END OF SECTION

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SECTION 21 05 00 - COMMON WORK RESULTS FOR FIRE SUPPRESSION

PART 1 - GENERAL

1.1 SUMMARY

A. The Work of this Section includes:

1. Motors.
2. Sleeves without waterstop.
3. Sleeves with waterstop.
4. Stack-sleeve fittings.
5. Sleeve-seal systems.
6. Grout.
7. Silicone sealants.
8. Escutcheons.

1.2 DEFINITIONS

A. Existing Piping to Remain: Existing piping that is not to be removed and that is not otherwise indicated to be removed, removed and salvaged, or removed and reinstalled.

1.3 ACTION SUBMITTALS

A. Product Data:

1. For each type of product, excluding motors which are included in Part 1 of the fire-suppression equipment Sections.

a. Include construction details, material descriptions, and dimensions of components.
b. Include operating characteristics and furnished accessories.

1.4 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

1.5 COORDINATION

A. Coordinate features of motors, installed units, and accessory devices to be compatible with the following:

1. Motor controllers.
2. Torque, speed, and horsepower requirements of the load.
3. Ratings and characteristics of supply circuit and required control sequence.

4. Ambient and environmental conditions of installation location.

PART 2 - PRODUCTS

2.1 MOTORS

A. Motor Requirements, General:

1. Content includes motors for use on alternating-current power systems of up to 600 V and installed at equipment manufacturer's factory or shipped separately by equipment manufacturer for field installation.
2. Comply with requirements in this Section except when stricter requirements are specified in equipment schedules or Sections.
3. Comply with NEMA MG 1 unless otherwise indicated.

B. Motor Characteristics:

1. Duty: Continuous duty at ambient temperature of 40 deg C and at altitude of **3300 ft.** above sea level.
2. Capacity and Torque Characteristics: Sufficient to start, accelerate, and operate connected loads at designated speeds, at installed altitude and environment, with indicated operating sequence, and without exceeding nameplate ratings or considering service factor.

C. Polyphase Motors:

1. Description: NEMA MG 1, Design B, medium induction motor.
2. Efficiency: Premium Efficient, as defined in NEMA MG 1.
3. Service Factor: 1.15.
4. Multispeed Motors: Variable torque.
    a. For motors with 2:1 speed ratio, consequent pole, single winding.
    b. For motors with other than 2:1 speed ratio, separate winding for each speed.
5. Multispeed Motors, Multiple Winding: Separate winding for each speed.
6. Rotor: Random-wound, squirrel cage.
7. Bearings: Regreasable, shielded, antifriction ball bearings suitable for radial and thrust loading.
8. Temperature Rise: Match insulation rating.
9. Insulation: Class F.
10. Code Letter Designation:
    a. Motors 15 HP and Larger: NEMA starting Code F or Code G.
    b. Motors Smaller Than 15 HP: Manufacturer's standard starting characteristic.
11. Enclosure Material: Cast iron for motor frame sizes 324T and larger; rolled steel for motor frame sizes smaller than 324T.

D. Additional Requirements for Polyphase Motors:

1. Motors Used with Reduced-Voltage and Multispeed Controllers: Match wiring connection requirements for controller with required motor leads. Provide terminals in motor terminal box, suited to control method.
2. Motors Used with Variable-Frequency Controllers: Ratings, characteristics, and features coordinated with and approved by controller manufacturer.

    a. Windings: Copper magnet wire with moisture-resistant insulation varnish, designed and tested to resist transient spikes, high frequencies, and short time-rise pulses produced by pulse-width-modulated inverters.
    b. Premium-Efficient Motors: Class B temperature rise; Class F insulation.
    c. Inverter-Duty Motors: Class F temperature rise; Class H insulation.
    d. Thermal Protection: Comply with NEMA MG 1 requirements for thermally protected motors.

E. Single-Phase Motors:

1. Motors larger than 1/20 hp must be one of the following, to suit starting torque and requirements of specific motor application:

    a. Permanent-split capacitor.
    b. Split phase.
    c. Capacitor start, inductor run.
    d. Capacitor start, capacitor run.

2. Multispeed Motors: Variable-torque, permanent-split-capacitor type.
3. Bearings: Prelubricated, antifriction ball bearings or sleeve bearings suitable for radial and thrust loading.
4. Motors 1/20 HP and Smaller: Shaded-pole type.
5. Thermal Protection: Internal protection to automatically open power supply circuit to motor when winding temperature exceeds a safe value calibrated to temperature rating of motor insulation. Thermal-protection device will automatically reset when motor temperature returns to normal range.

F. Electronically Commutated Motors:

1. Microprocessor-Based Electronic Control Module: Converts 120 V or 240 V single-phase AC power to three-phase DC power to operate the brushless DC motor.
2. Three-phase power motor module with permanent magnet rotor.
3. Circuit board or digital speed controller/LED display.
4. Building Automation System Interface: Via AC voltage signal.

2.2 SLEEVES AND SLEEVE SEALS

A. Sleeves without Waterstop:

1. Cast-Iron Pipe Sleeves: Cast or fabricated of cast or ductile iron, with plain ends.
2. Steel Pipe Sleeves: ASTM A53/A53M, Type E, Grade B, Schedule 40, hot-dip

galvanized, with plain ends.

3. Steel Sheet Sleeves: ASTM A653/A653M, **24 gauge** minimum thickness; hot-dip galvanized, round tube closed with welded longitudinal joint.
4. PVC Pipe Sleeves: ASTM D1785, Schedule 40.
5. Molded-PVC Sleeves: With nailing flange.
6. Molded-PE or -PP Sleeves: Removable, tapered-cup shaped, and smooth outer surface with nailing flange.

B. Sleeves with Waterstop:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

   a. Advance Products & Systems, LLC
   b. CALPICO, Inc.
   c. GPT Industries, LLC.
   d. Metraflex Company (The)

2. Basis-of-Design Product: Subject to compliance with requirements, provide waterstop or comparable product by one of the following:

   a. Advance Products & Systems, LLC
   b. CALPICO, Inc.
   c. GPT Industries, LLC.
   d. Metraflex Company (The)

3. Description: Manufactured stainless steel, sleeve-type, waterstop assembly made for imbedding in concrete slab or wall.

C. Stack-Sleeve Fittings:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

   a. Jay R. Smith Mfg Co; a division of Morris Group International
   b. Wade; a subsidiary of McWane Inc.
   c. Zurn Industries, LLC

2. Basis-of-Design Product: Subject to compliance with requirements, provide stack-sleeve fittings or comparable product by one of the following:

   a. Jay R. Smith Mfg Co; a division of Morris Group International
   b. Wade; a subsidiary of McWane Inc.
   c. Zurn Industries, LLC

3. Description: Manufactured, galvanized cast-iron sleeve with integral clamping flange for use in waterproof floors and roofs. Include clamping ring, bolts, and nuts for membrane flashing.

a. Underdeck Clamp: Clamping ring with setscrews.

D. Sleeve-Seal Systems:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Advance Products & Systems, LLC
b. CALPICO, Inc.
c. GPT Industries, LLC.
d. Metraflex Company (The)
e. Proco Products, Inc

2. Basis-of-Design Product: Subject to compliance with requirements, provide sleeve-seal or comparable product by one of the following:

a. Advance Products & Systems, LLC
b. CALPICO, Inc.
c. GPT Industries, LLC.
d. Metraflex Company (The)
e. Proco Products, Inc

3. Description: Modular sealing-element unit, designed for field assembly, for filling annular space between piping and sleeve.

a. Hydrostatic Seal: **20 psig** minimum.
b. Sealing Elements: EPDM-rubber interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size.
c. Pressure Plates: Stainless steel.
d. Connecting Bolts and Nuts: Stainless steel of length required to secure pressure plates to sealing elements.

E. Grout:

1. Description: Nonshrink, for interior and exterior sealing openings in non-fire-rated walls or floors.
2. Standard: ASTM C1107/C1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.
3. Design Mix: **5000 psi**, 28-day compressive strength.
4. Packaging: Premixed and factory packaged.

F. Silicone Sealants:

1. Silicone Sealant, S, NS, 25, NT: Single-component, nonsag, plus 25 percent and minus 25 percent movement capability, nontraffic-use, neutral-curing silicone joint sealant.

a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1) GE Construction Sealants; Momentive Performance Materials Inc.
2) ITW Polymers Sealants North America
3) Polymeric Systems, Inc.; PPG Industries, Inc.
4) Sherwin-Williams Company (The)
5) Sika Corporation
6) The Dow Chemical Company
7) Tremco Incorporated

b. Basis-of-Design Product: Subject to compliance with requirements, provide sealant or comparable product by one of the following:

1) GE Construction Sealants; Momentive Performance Materials Inc.
2) ITW Polymers Sealants North America
3) Polymeric Systems, Inc.; PPG Industries, Inc.
4) Sherwin-Williams Company (The)
5) Sika Corporation
6) The Dow Chemical Company
7) Tremco Incorporated

c. Standard: ASTM C920, Type S, Grade NS, Class 25, Use NT.

2. Silicone Sealant, S, P, T, NT: Single-component, 25, pourable, plus 25 percent and minus 25 percent movement capability, traffic- and nontraffic-use, neutral-curing silicone joint sealant.

a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1) Pecora Corporation
2) Sika Corporation
3) The Dow Chemical Company
4) Tremco Incorporated

b. Basis-of-Design Product: Subject to compliance with requirements, provide sealant or comparable product by one of the following:

1) Pecora Corporation
2) Sika Corporation
3) The Dow Chemical Company
4) Tremco Incorporated

c. Standard: ASTM C920, Type S, Grade P, Class 25, Uses T and NT.

3. Silicone Foam Sealant: Multicomponent, silicone-based liquid elastomers that, when mixed, expand and cure in place to produce a flexible, nonshrinking foam.

a. Manufacturers: Subject to compliance with requirements, provide products by the following:

1) Smooth-On

b. Basis-of-Design Product: Subject to compliance with requirements, provide sealant or comparable product by one of the following:

1) Smooth-On

4. Sealant shall have a VOC content of 250 g/L or less.

a. Sealant shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
b. Sealant shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
c. Sealant shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers." Formaldehyde emissions shall not exceed 9 mcg/cu. m or 7 ppb, whichever is less.
d. Sealant shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
e. Sealant shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers." The building concentration of formaldehyde shall not exceed half of the indoor recommended exposure limit, or 33 mcg/cu. m, and that of acetaldehyde shall not exceed 9 mcg/cu. m.

2.3 ESCUTCHEONS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. BrassCraft Manufacturing Co.; a Masco company
2. Dearborn Brass
3. Jones Stephens Corp.
4. Keeney Manufacturing Company (The)
5. Mid-America Fittings, LLC; A Midland Industries Company
6. ProFlo; a Ferguson Enterprises, Inc. brand

B. Escutcheon Types:

1. One-Piece, Steel Type: With polished brass finish and setscrew fastener.
2. One-Piece, Stainless Steel Type: With polished stainless steel finish.
3. One-Piece, Cast-Brass Type: With polished brass finish and setscrew fastener.

4. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped brass with polished, chrome-plated finish and spring-clip fasteners.
5. One-Piece, Stamped-Steel Type: With polished, chrome-plated finish and spring-clip fasteners.
6. Split-Plate, Stamped-Steel Type: With polished, chrome-plated finish; concealed and exposed-rivet hinge; and spring-clip fasteners.

C. Floor Plates:

1. Split Floor Plates: Steel with concealed hinge.

PART 3 - EXECUTION

3.1 INSTALLATION OF PIPE LOOPS AND SWING CONNECTIONS

A. Install pipe loops and offsets in accordance with NFPA 13 requirements for expansion and contraction compensation.

3.2 INSTALLATION OF SLEEVES, GENERAL

A. Install sleeves for piping passing through penetrations in floors, partitions, roofs, and walls.

B. For sleeves that will have sleeve-seal system installed, select sleeves of size large enough to provide 1-inch annular clear space between piping and concrete slabs and walls.

1. Sleeves are not required for core-drilled holes.

C. Install sleeves in concrete floors, concrete roof slabs, and concrete walls as new slabs and walls are constructed.

1. Permanent sleeves are not required for holes in slabs formed by molded-PE or -PP sleeves.
2. Cut sleeves to length for mounting flush with both surfaces.

a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches above finished floor level.

3. Using grout or silicone sealant, seal space outside of sleeves in floors/slabs/walls without sleeve-seal system. Select to maintain fire-resistance of floor/slab/wall.

D. Install sleeves for pipes passing through interior partitions.

1. Cut sleeves to length for mounting flush with both surfaces.
2. Install sleeves that are large enough to provide **1/4-inch** annular clear space between sleeve and pipe or pipe insulation.
3. Seal annular space between sleeve and piping or piping insulation; use joint sealants that joint sealant manufacturer's literature indicates is appropriate for

size, depth, and location of joint.

E. Fire-Resistance-Rated Penetrations, Horizontal Assembly Penetrations, and Smoke Barrier Penetrations: Maintain indicated fire or smoke rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with fire- and smoke-stop materials. Comply with requirements for firestopping and fill materials specified in Section 078413 "Penetration Firestopping."

3.3 INSTALLATION OF SLEEVES WITH WATERSTOP

A. Install sleeve with waterstop as new walls and slabs are constructed.

B. Assemble fitting components of length to be flush with both surfaces of concrete slabs and walls. Position waterstop flange centered across width centered in concrete slab or wall.

C. Secure nailing flanges to wooden concrete forms.

D. Using grout or silicone sealant, seal space around outside of sleeves.

3.4 INSTALLATION OF STACK-SLEEVE FITTINGS

A. Install stack-sleeve fittings in new slabs as slabs are constructed.

1. Install fittings that are large enough to provide **1/4-inch** annular clear space between sleeve and pipe or pipe insulation.
2. Secure flashing between clamping flanges for pipes penetrating floors with membrane waterproofing. Comply with requirements for flashing specified in Section 076200 "Sheet Metal Flashing and Trim."
3. Install section of cast-iron soil pipe to extend sleeve to **3 inches** above finished floor level.
4. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified.
5. Using silicone sealant, seal space between top hub of stack-sleeve fitting and pipe.

B. Fire-Resistance-Rated Penetrations, Horizontal Assembly Penetrations, and Smoke Barrier Penetrations: Maintain indicated fire or smoke rating of floors at pipe penetrations. Seal pipe penetrations with fire- or smoke-stop materials. Comply with requirements for firestopping specified in Section 078413 "Penetration Firestopping."

3.5 INSTALLATION OF SLEEVE-SEAL SYSTEMS

A. Install sleeve-seal systems in sleeves in exterior concrete walls and slabs-on-grade at service piping entries into building, and passing through exterior walls.

B. Select type, size, and number of sealing elements required for piping material and size and for sleeve ID or hole size. Assemble sleeve-seal system components, and install in annular space between piping and sleeve. Tighten bolts against pressure plates that

cause sealing elements to expand and make a watertight seal.

3.6 INSTALLATION OF ESCUTCHEONS

A. Install escutcheons for piping penetrations of walls, ceilings, and finished floors.

B. Install escutcheons with ID to closely fit around pipe, tube, and insulation of piping and with OD that completely covers opening.

3.7 FIELD QUALITY CONTROL

A. Sleeves and Sleeve Seals:

1. Perform the following tests and inspections:

a. Leak Test: After allowing for a full cure, test sleeves and sleeve seals for leaks. Repair leaks and retest until no leaks exist.
b. Sleeves and sleeve seals will be considered defective if they do not pass tests and inspections.

2. Prepare test and inspection reports.

B. Escutcheons:

1. Using new materials, replace broken and damaged escutcheons and floor plates.

3.8 SLEEVES APPLICATION

A. Use sleeves and sleeve seals for the following piping-penetration applications:

1. Exterior Concrete Walls above and below Grade:

a. Sleeves with waterstops.

1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.

2. Concrete Slabs-on-Grade:

a. Sleeves with waterstops.

1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.

3. Concrete Slabs above Grade:

a. Sleeves with waterstops or stack-sleeve fittings.

4. Interior Walls and Partitions:

a. Sleeves without waterstops.

3.9 ESCUTCHEONS APPLICATION

A. Escutcheons for New Piping and Relocated Existing Piping:

1. Piping with Fitting or Sleeve Protruding from Wall: One piece, deep pattern.
2. Chrome-Plated Piping: One piece , steel , cast brass or split plate steel with polished, chrome-plated finish.
3. Insulated Piping:

    a. One piece, steel with polished, chrome-plated finish.
    b. One piece, stainless steel with polished stainless steel finish.
    c. One piece, cast brass with polished, chrome-plated finish.
    d. One piece, stamped steel or split plate, stamped steel with concealed hinge with polished, chrome-plated finish.

4. Bare Piping at Wall and Floor Penetrations in Finished Spaces:

    a. One piece, steel with polished, chrome-plated finish.
    b. One piece, stainless steel with polished stainless steel finish.
    c. One piece, cast brass with polished, chrome-plated finish.
    d. One piece, stamped steel or split plate, stamped steel with concealed hinge with polished, chrome-plated finish.

5. Bare Piping at Ceiling Penetrations in Finished Spaces:

    a. One piece, steel with polished, chrome-plated finish.
    b. One piece, stainless steel with polished stainless steel finish.
    c. One piece, cast brass with polished, chrome-plated finish.
    d. One piece, stamped steel or split plate, stamped steel with concealed hinge with polished, chrome-plated finish.

6. Bare Piping in Unfinished Service Spaces:

    a. One piece, steel with polished, chrome-plated finish.
    b. One piece, cast brass with polished, chrome-plated finish.
    c. One piece, stamped steel or split plate, stamped steel with concealed hinge with polished, chrome-plated finish.

7. Bare Piping in Equipment Rooms:

    a. One piece, steel with polished, chrome-plated finish.
    b. One piece, cast brass with polished, chrome-plated finish.
    c. One piece, stamped steel or split plate, stamped steel with concealed hinge with polished, chrome-plated finish.

B. Escutcheons for Existing Piping to Remain:

1. Chrome-Plated Piping: Split plate, stamped steel with concealed or exposed-rivet

hinge with polished, chrome-plated finish.

2. Insulated Piping: Split plate, stamped steel with concealed or exposed-rivet hinge with polished, chrome-plated finish.
3. Bare Piping at Wall and Floor Penetrations in Finished Spaces: Split plate, stamped steel with concealed or exposed-rivet hinge with polished, chrome-plated finish.
4. Bare Piping at Ceiling Penetrations in Finished Spaces: Split plate, stamped steel with concealed or exposed-rivet hinge with polished, chrome-plated finish.
5. Bare Piping in Unfinished Service Spaces: Split plate, stamped steel with concealed or exposed-rivet hinge with polished, chrome-plated finish.
6. Bare Piping in Equipment Rooms: Split plate, stamped steel with concealed or exposed-rivet hinge with polished, chrome-plated finish.

C. Install floor plates for piping penetrations of equipment room floors.

D. Install floor plates with ID to closely fit around pipe, tube, and insulation of piping and with OD that completely covers opening.

1. New Piping and Relocated Existing Piping: One piece, floor plate.
2. Existing Piping: Split floor plate.

END OF SECTION 21 05 00

SECTION 21 05 23 - GENERAL-DUTY VALVES FOR WATER-BASED FIRE-SUPPRESSION PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Two-piece ball valves with indicators.
2. Iron butterfly valves with indicators.
3. Check valves.
4. Bronze OS&Y gate valves.
5. Trim and drain valves.

1.2 DEFINITIONS

A. NRS: Nonrising stem.

B. OS&Y: Outside screw and yoke.

C. SBR: Styrene-butadiene rubber.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of valve.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Prepare valves for shipping as follows:

1. Protect internal parts against rust and corrosion.
2. Protect threads, flange faces, and weld ends.
3. Set valves open to minimize exposure of functional surfaces.

B. Use the following precautions during storage:

1. Maintain valve end protection.
2. Store valves indoors and maintain at higher-than-ambient dew point temperature. If outdoor storage is necessary, store valves off the ground in watertight enclosures.

C. Use sling to handle large valves; rig sling to avoid damage to exposed parts. Do not use operating handles or stems as lifting or rigging points.

D. Protect flanges and specialties from moisture and dirt.

PART 2 - PRODUCTS

2.1 SOURCE LIMITATIONS

A. Obtain each type of valve from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

A. UL Listed: Valves shall be listed in UL's "Online Certifications Directory" under the headings listed below and shall bear UL mark:

1. Fire Main Equipment: HAMV - Main Level.

a. Indicator Posts, Gate Valve: HCBZ - Level 1.
b. Ball Valves, System Control: HLUG - Level 3.
c. Butterfly Valves: HLXS - Level 3.
d. Check Valves: HMER - Level 3.
e. Gate Valves: HMRZ - Level 3.

2. Sprinkler System and Water Spray System Devices: VDGT - Main Level.

a. Valves, Trim and Drain: VQGU - Level 1.

B. FM Global Approved: Valves shall be listed in its "Approval Guide," under the headings listed below:

1. Automated Sprinkler Systems:

a. Indicator posts.
b. Valves.

1) Gate valves.
2) Check valves.
3) Miscellaneous valves.

C. ASME Compliance:

1. ASME B1.20.1 for threads for threaded-end valves.
2. ASME B16.1 for flanges on iron valves.
3. ASME B31.9 for building services piping valves.

D. AWWA Compliance: Comply with AWWA C606 for grooved-end connections.

E. NFPA Compliance for Valves:

1. Comply with NFPA 13, NFPA 14, NFPA 20, and NFPA 24.

F. Valve Pressure Ratings: Not less than the minimum pressure rating indicated or higher, as required by system pressures.

G. Valve Sizes: Same as upstream piping unless otherwise indicated.

H. Valve Actuator Types:

1. Worm-gear actuator with handwheel for quarter-turn valves, except for trim and drain valves.
2. Handwheel: For other than quarter-turn trim and drain valves.
3. Handlever: For quarter-turn trim and drain valves **NPS 2** and smaller.

2.3 TWO-PIECE BALL VALVES WITH INDICATORS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Ames Fire & Waterworks; A Watts Water Technologies Company
2. NIBCO INC.
3. Victaulic Company

B. Description:

1. UL 1091, except with ball instead of disc and FM Global approved for indicating valves (butterfly or ball type), Class Number 1112.
2. Minimum Pressure Rating: **175 psig**.
3. Body Design: Two piece.
4. Body Material: Forged brass or bronze.
5. Port Size: Full or standard.
6. Seats: PTFE.
7. Stem: Bronze or stainless steel.
8. Ball: Chrome-plated brass.
9. Actuator: Worm gear
10. Supervisory Switch: Internal or external.
11. End Connections for Valves **NPS 1** through **NPS 2**: Threaded ends.
12. End Connections for Valves **NPS 2-1/2**: Grooved ends.

2.4 IRON BUTTERFLY VALVES WITH INDICATORS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. ALEUM USA
2. Anvil; an ASC Engineered Solution
3. Globe Fire Sprinkler Corporation
4. Kennedy Valve Company; a division of McWane, Inc.
5. NIBCO INC.
6. Tyco Fire Products; brand of Johnson Controls International plc, Building Solutions North America
7. Victaulic Company

8. Zurn Industries, LLC

B. Description:

1. Standard: UL 1091 and FM Global standard for indicating valves, (butterfly or ball type), Class Number 112.
2. Minimum Pressure Rating: **175 psig**.
3. Body Material: Cast or ductile iron with nylon, EPDM, epoxy, or polyamide coating.
4. Seat Material: EPDM.
5. Stem: Stainless steel.
6. Disc: Ductile iron, and EPDM or SBR coated.
7. Actuator: Worm gear.
8. Supervisory Switch: Internal or external.
9. Body Design: Grooved-end connections.

2.5 CHECK VALVES

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. ALEUM USA
2. Ames Fire & Waterworks; A Watts Water Technologies Company
3. Anvil; an ASC Engineered Solution
4. FEBCO; A WATTS Brand
5. Fire Protection Products Inc (FPPI); a brand of Anvil International and Smith-Cooper International
6. Globe Fire Sprinkler Corporation
7. Kennedy Valve Company; a division of McWane, Inc.
8. Matco-Norca
9. Mueller Co. LLC; Mueller Water Products, Inc.
10. NIBCO INC.
11. Reliable Automatic Sprinkler Co., Inc. (The)
12. Shurjoint; a part of Aalberts Integrated Piping Systems
13. Tyco Fire Products; brand of Johnson Controls International plc, Building Solutions North America
14. United Brass Works, Inc
15. Venus Fire Protection Ltd.
16. Victaulic Company
17. Viking Group Inc.
18. WATTS; A Watts Water Technologies Company
19. Wilson & Cousins Inc.
20. Zurn Industries, LLC

B. Description:

1. Standard: UL 312 and FM Global standard for swing check valves, Class Number 1210.
2. Minimum Pressure Rating: **175 psig**.

3. Type: Single swing check.
4. Body Material: Cast iron, ductile iron, or bronze.
5. Clapper: Bronze, ductile iron, or stainless steel with elastomeric seal.
6. Clapper Seat: Brass, bronze, or stainless steel.
7. Hinge Shaft: Bronze or stainless steel.
8. Hinge Spring: Stainless steel.
9. End Connections: Flanged, grooved, or threaded.

2.6 BRONZE OS&Y GATE VALVES

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Milwaukee Valve Company
2. NIBCO INC.
3. United Brass Works, Inc
4. Zurn Industries, LLC

B. Description:

1. Standard: UL 262 and FM Global standard for fire-service water control valves (OS&Y- and NRS-type gate valves).
2. Minimum Pressure Rating: **175 psig**.
3. Body and Bonnet Material: Bronze or brass.
4. Wedge: One-piece bronze or brass.
5. Wedge Seat: Bronze.
6. Stem: Bronze or brass.
7. Packing: Non-asbestos PTFE.
8. Supervisory Switch: External.
9. End Connections: Threaded.

2.7 TRIM AND DRAIN VALVES

A. Ball Valves:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Apollo Valves; a part of Aalberts Integrated Piping Systems
b. Croker; a Division of Morris Group International
c. Fire Protection Products Inc (FPPI); a brand of Anvil International and Smith-Cooper International
d. Flowserve Corporation
e. Jomar Valve
f. KITZ Corporation
g. Metso Automation USA Inc.
h. Milwaukee Valve Company

i. NIBCO INC.
j. Potter Roemer LLC; a Division of Morris Group International
k. Red-White Valve Corp.
l. Tyco Fire Products; brand of Johnson Controls International plc, Building Solutions North America
m. Victaulic Company
n. WATTS; A Watts Water Technologies Company
o. Zurn Industries, LLC

2. Description:

a. Pressure Rating: 175 psig.
b. Body Design: Two piece.
c. Body Material: Forged brass or bronze.
d. Port size: Full or standard.
e. Seats: PTFE.
f. Stem: Bronze or stainless steel.
g. Ball: Chrome-plated brass.
h. Actuator: Handlever.
i. End Connections for Valves **NPS 1** through **NPS 2-1/2**: Threaded ends.
j. End Connections for Valves **NPS 1-1/4 and NPS 2-1/2**: Grooved ends.

B. Angle Valves:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Fire Protection Products Inc (FPPI); a brand of Anvil International and Smith-Cooper International
b. NIBCO INC.
c. United Brass Works, Inc

2. Description:

a. Pressure Rating: 175 psig.
b. Body Material: Brass or bronze.
c. Ends: Threaded.
d. Stem: Bronze.
e. Disc: Bronze.
f. Packing: Asbestos free.
g. Handwheel: Malleable iron, bronze, or aluminum.

C. Globe Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by the following:

a. NIBCO INC.
b. United Brass Works, Inc

2. Description:

   a. Pressure Rating: 175 psig.
   b. Body Material: Bronze with integral seat and screw-in bonnet.
   c. Ends: Threaded.
   d. Stem: Bronze.
   e. Disc Holder and Nut: Bronze.
   f. Disc Seat: Nitrile.
   g. Packing: Asbestos free.
   h. Handwheel: Malleable iron, bronze, or aluminum.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.

B. Operate valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations.

C. Examine threads on valve and mating pipe for form and cleanliness.

D. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Verify that gasket is of proper size, that its material composition is suitable for service, and that it is free from defects and damage.

E. Do not attempt to repair defective valves; replace with new valves.

3.2 INSTALLATION, GENERAL

A. Comply with requirements in the following Sections for specific valve-installation requirements and applications:

   1. Section 211000 "Water-Based Fire-Suppression Systems" for application of valves in fire-suppression standpipes; wet-pipe, fire-suppression sprinkler systems; and dry-pipe, fire-suppression sprinkler systems.
   2. Section 211339 "Foam-Water Systems" for application of valves in AFFF piping.
   3. Section 331415 "Site Water Distribution Piping" for application of valves in fire-suppression water-service piping.

B. Install listed fire-protection shutoff valves supervised-open, located to control sources of water supply, except from fire-department connections. Install permanent identification signs, indicating portion of system controlled by each valve.

C. Install double-check valve assembly in each fire-protection water-supply connection.

D. Install valves having threaded connections with unions at each piece of equipment

arranged to allow easy access, service, maintenance, and equipment removal without system shutdown. Provide separate support where necessary.

E. Install valves in horizontal piping with stem at or above the pipe center.

F. Install valves in position to allow full stem movement.

G. Install valve tags. Comply with requirements in Section 210553 "Identification for Fire-Suppression Piping and Equipment" for valve tags and schedules and signs on surfaces concealing valves; and the NFPA standard applying to the piping system in which valves are installed. Install permanent identification signs indicating the portion of system controlled by each valve.

END OF SECTION 21 05 23

SECTION 21 05 29 - HANGERS AND SUPPORTS FOR FIRE-SUPPRESSION PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Pipe hangers for fire-suppression piping - metal, trapeze type.
2. Equipment supports.

B. Related Requirements:

1. Section 055000 "Metal Fabrications" for structural-steel shapes and plates for trapeze hangers for pipe and equipment supports.
2. Section 210548.13 "Vibration Controls for Fire-Suppression Piping and Equipment" for vibration isolation devices.

1.2 ACTION SUBMITTALS

A. Product Data:

1. For each type of product.

B. Shop Drawings: Signed and sealed by a qualified professional engineer. Show fabrication and installation details and include calculations for the following:

1. Trapeze pipe hangers.
2. Equipment supports.

C. Delegated Design Submittals: For trapeze hangers indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1. Detail fabrication and assembly of trapeze hangers.
2. Include design calculations for designing trapeze hangers.

1.3 INFORMATIONAL SUBMITTALS

A. Welding certificates.

1.4 QUALITY ASSURANCE

A. Structural-Steel Welding Qualifications: Qualify procedures and personnel in accordance with AWS D1.1/D1.1M.

B. Pipe Welding Qualifications: Qualify procedures and operators in accordance with 2021 ASME Boiler and Pressure Vessel Code, Section IX.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design trapeze pipe hangers and equipment supports.

B. Structural Performance: Hangers and supports for fire-suppression piping and equipment are to withstand the effects of gravity loads and stresses within limits and under conditions indicated in accordance with ASCE/SEI 7.

1. Design supports for multiple pipes, including pipe stands capable of supporting combined weight of supported systems, system contents, and test water.
2. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.
3. Design seismic-restraint hangers and supports for piping and equipment and obtain approval from authorities having jurisdiction.

C. NFPA Compliance: Comply with NFPA 13 NFPA 13R.

D. UL Compliance: Comply with UL 203.

2.2 PIPE HANGERS FOR FIRE-SUPPRESSION PIPING - METAL, TRAPEZE TYPE

A. Description: MSS SP-58, Type 59, shop- or field-fabricated pipe-support assembly, made from structural-carbon-steel shapes, with NFPA-approved, UL-listed, or FM Global-approved carbon-steel hanger rods, nuts, saddles, and U-bolts.

2.3 EQUIPMENT SUPPORTS

A. Description: NFPA-approved, UL-listed, or FM Global-approved, welded, shop- or field-fabricated equipment support, made from structural-carbon-steel shapes.

2.4 MATERIALS

A. Aluminum: **ASTM B221**.

B. Carbon Steel: ASTM A1011/A1011M.

C. Structural Steel: ASTM A36/A36M, carbon-steel plates, shapes, and bars; black and galvanized.

D. Stainless Steel: ASTM A240/A240M.

E. Grout: ASTM C1107/C1107M, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink and nonmetallic grout, suitable for interior and exterior applications.

1. Properties: Nonstaining, noncorrosive, and nongaseous.
2. Design Mix: **5000 psi**, 28-day compressive strength.

PART 3 - EXECUTION

3.1 APPLICATION

A. Comply with requirements in Section 078413 "Penetration Firestopping" for firestopping materials and installation, for penetrations through fire-rated walls, ceilings, and assemblies.

B. Strength of Support Assemblies: Where not indicated, select sizes of components, so strength will be adequate to carry static loads within specified loading limits. Minimum static design load used for strength determination is to comply with NFPA 13 requirements, minimum 5 times the water-filled weight of piping and supported components plus 250 lb.

3.2 INSTALLATION OF HANGERS AND SUPPORTS

A. Install hangers and supports to allow controlled thermal and seismic movement of piping systems, permit freedom of movement between pipe anchors, and facilitate action of expansion joints, expansion loops, expansion bends, and similar units.

B. Install lateral bracing with pipe hangers and supports to prevent swaying.

C. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, NPS 2-1/2 and larger and at changes in direction of piping. Coordinate location of concrete inserts before concrete is placed.

D. Load Distribution: Install hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.

E. Pipe Slopes: Install hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.

F. Metal Pipe-Hanger Installation: Comply with installation requirements of approvals and listings. Install hangers, supports, clamps, and attachments as required to properly support piping from building structure.

G. Metal Trapeze Pipe-Hanger Installation: Comply with MSS SP-58. Arrange for grouping of parallel runs of horizontal piping, and support together on field-fabricated trapeze pipe hangers.

1. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size, or install intermediate supports for smaller-diameter pipes as specified for

individual pipe hangers.
2. Field fabricate from ASTM A36/A36M carbon-steel shapes selected for loads being supported. Weld steel in accordance with AWS D1.1/D1.1M.

H. Thermal Hanger-Shield Installation: Install in pipe hanger or shield for insulated piping.

I. Fastener System Installation:

1. Install powder-actuated fasteners for use in lightweight concrete or concrete slabs less than **4 inches** thick in concrete, after concrete is placed and completely cured. Use operators that are licensed by powder-actuated tool manufacturer. Install fasteners in accordance with powder-actuated tool manufacturer's operating manual. Install in accordance with approvals and listings.
2. Install mechanical-expansion anchors in concrete, after concrete is placed and completely cured. Install fasteners in accordance with manufacturer's written instructions. Install in accordance with approvals and listings.

J. Install hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.

K. Equipment Support Installation:

1. Fabricate from welded-structural-steel shapes.
2. Grouting: Place grout under supports for floor-mounted equipment and make bearing surface smooth.
3. Provide lateral bracing, to prevent swaying.

L. Insulated Piping:

1. Attach clamps and spacers to piping.

   a. Piping Operating Above Ambient Air Temperature: Clamp may project through insulation.
   b. Piping Operating Below Ambient Air Temperature: Use thermal hanger-shield insert with clamp sized to match OD of insert.
   c. Do not exceed pipe stress limits allowed by ASME B31.9 for building services piping.

2. Install MSS SP-58, Type 39 protection saddles if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.

   a. MSS SP-58, Type 39 Option: Thermal hanger-shield inserts may be used. Include steel weight-distribution plate for pipe **NPS 4** and larger if pipe is installed on rollers.

3. Install MSS SP-58, Type 40 protective shields on cold piping with vapor barrier. Shields are to span an arc of 180 degrees.

   a. MSS SP-58, Type 40 Option: Thermal hanger-shield inserts may be used. Include steel weight-distribution plate for pipe **NPS 4** and larger if pipe is

installed on rollers.

4. Shield Dimensions for Pipe: Not less than the following:

   a. NPS 1/4 to NPS 3-1/2 (DN 8 to DN 90): **12 inches** long and **0.048 inch** thick.
   b. NPS 4 (DN 100): **12 inches** long and **0.06 inch** thick.
   c. NPS 5 and NPS 6 (DN 125 and DN 150): **18 inches** long and **0.06 inch** thick.
   d. NPS 8 to NPS 14 (DN 200 to DN 350): **24 inches** long and **0.075 inch** thick.
   e. NPS 16 to NPS 24 (DN 400 to DN 600): **24 inches** long and **0.105 inch** thick.

5. Pipes NPS 8 (DN 200) and Larger: Include wood or reinforced calcium-silicate-insulation inserts of length at least as long as protective shield.
6. Thermal Hanger Shields: Install with insulation of same thickness as piping insulation.

3.3 INSTALLATION OF EQUIPMENT SUPPORTS

A. Fabricate structural-steel stands to suspend equipment from structure overhead or to support equipment above floor.

B. Grouting: Place grout under supports for equipment, and make bearing surface smooth.

C. Provide lateral bracing, to prevent swaying, for equipment supports.

3.4 METAL FABRICATIONS

A. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers and equipment supports.

B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.

C. Field Welding: Comply with AWS D1.1/D1.1M procedures for shielded, metal arc welding; appearance and quality of welds; and methods used in correcting welding work; and with the following:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove welding flux immediately.
4. Finish welds at exposed connections, so no roughness shows after finishing and so contours of welded surfaces match adjacent contours.

3.5 ADJUSTING

A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.

B. Trim excess length of continuous-thread hanger and support rods to 1-1/2 inches.

3.6 PAINTING

A. Touchup:

1. Clean field welds and abraded, shop-painted areas. Paint exposed areas immediately after erecting hangers and supports. Use same materials as those used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.

   a. Apply paint by brush or spray to provide a minimum dry film thickness of **2.0 mils**.

2. Cleaning and touchup painting of field welds, bolted connections, and abraded, shop-painted areas on miscellaneous metal are specified in Section 099113 "Exterior Painting."

B. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas, and apply galvanizing-repair paint to comply with ASTM A780/A780M.

3.7 HANGER AND SUPPORT SCHEDULE

A. Specific hanger and support requirements are in Sections specifying piping systems and equipment.

B. Comply with NFPA requirements for pipe-hanger selections and applications that are not specified in piping system Sections.

C. Use hangers and supports with galvanized metallic coatings for piping and equipment that will not have field-applied finishes.

D. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.

E. Use carbon-steel pipe hangers and supports and metal trapeze pipe hangers and attachments for general service applications.

F. Use stainless steel pipe hangers and stainless steel or corrosion-resistant attachments for hostile environment applications.

G. Use copper-plated pipe hangers and copper or stainless steel attachments for copper piping and tubing.

H. Use thermal hanger-shield inserts for insulated piping and tubing.

I. Horizontal-Piping Hangers and Supports: Comply with NFPA requirements. Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of noninsulated or insulated, stationary pipes **NPS 1/2 to NPS 30**.
2. Steel Pipe Clamps (MSS Type 4): For suspension of **NPS 1/2 to NPS 24** if little or no insulation is required.
3. Adjustable, Swivel-Ring Band Hangers (MSS Type 10): For suspension of noninsulated, stationary pipes **NPS 1/2 to NPS 8**.
4. Split Pipe Ring with or without Turnbuckle Hangers (MSS Type 11): For suspension of noninsulated, stationary pipes **NPS 3/8 to NPS 8**.
5. Extension Hinged or Two-Bolt Split Pipe Clamps (MSS Type 12): For suspension of noninsulated, stationary pipes **NPS 3/8 to NPS 3**.
6. U-Bolts (MSS Type 24): For support of heavy pipes **NPS 1/2 to NPS 30**.
7. Pipe Saddle Supports (MSS Type 36): For support of pipes **NPS 4 to NPS 36**, with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate.
8. Pipe Stanchion Saddles (MSS Type 37): For support of pipes **NPS 4 to NPS 36**, with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate, and with U-bolt to retain pipe.
9. Adjustable Pipe Saddle Supports (MSS Type 38): For stanchion-type support for pipes **NPS 2-1/2 to NPS 36** if vertical adjustment is required, with steel-pipe base stanchion support and cast-iron floor flange.

J. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers **NPS 3/4 to NPS 24**.
2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers **NPS 3/4 to NPS 24** if longer ends are required for riser clamps.

K. Hanger-Rod Attachments: Comply with NFPA requirements.

L. Building Attachments: Comply with NFPA requirements. Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Steel or Malleable-Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete ceiling.
2. C-Clamps (MSS Type 23): For structural shapes.
3. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.

M. Saddles and Shields: Comply with NFPA requirements. Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Steel-Pipe-Covering Protection Saddles (MSS Type 39): To fill interior voids with insulation that matches adjoining insulation.
2. Protection Shields (MSS Type 40): Of length recommended in writing by manufacturer to prevent crushing insulation.
3. Thermal Hanger-Shield Inserts: For supporting insulated pipe.

N. Comply with NFPA requirements for trapeze pipe-hanger selections and applications that are not specified in piping system Sections.

O. Use powder-actuated fasteners or mechanical-expansion anchors instead of building attachments where required in concrete construction.

END OF SECTION 21 05 29

SECTION 21 05 48.13 - VIBRATION CONTROLS FOR FIRE-SUPPRESSION PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Elastomeric isolation mounts.
2. Restrained elastomeric isolation mounts.
3. Snubbers.
4. Restraints - rigid type.
5. Post-installed concrete anchors.

B. Related Requirements:

1. Section 220548.13 "Vibration Controls for Plumbing Piping and Equipment" for devices for plumbing equipment and systems.
2. Section 230548.13 "Vibration Controls for HVAC" for devices for HVAC equipment and systems.

1.2 DEFINITIONS

A. IBC: International Building Code.

B. OSHPD: Office of Statewide Health Planning and Development (for the State of California).

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include rated load, rated deflection, and overload capacity for each vibration isolation device.
2. Include load rating for each wind-load-restraint fitting and assembly.
3. Illustrate and indicate style, material, strength, fastening provision, and finish for each type and size of vibration isolation device and wind-load-restraint component.
4. Annotate to indicate application of each product submitted and compliance with requirements.
5. Interlocking Snubbers: Include ratings for horizontal, vertical, and combined loads.

B. Shop Drawings:

1. Detail fabrication and assembly of equipment bases. Detail fabrication including

anchorages and attachments to structure and to supported equipment. Include adjustable motor bases, rails, and frames for equipment mounting.

C. Delegated-Design Submittal:

1. For each wind-load protection device that is required by this Section or is indicated on Drawings, submit the following:

    a. Wind-Load-Restraint Selection: Select wind-load restraints complying with performance requirements, design criteria, and analysis data.
    b. Riser Supports: Include riser diagrams and calculations showing anticipated expansion and contraction at each support point, initial and final loads on building structure. Include certification by professional engineer that riser system was examined for excessive stress and that none exists.
    c. Post-Installed Concrete Anchors and Inserts: Include calculations showing anticipated wind loads.
    d. Wind-Load Design Calculations: Submit all static and dynamic loading calculations prepared under "Wind-Load Design Calculations" Paragraph in "Performance Requirements" Article.
    e. Qualified Professional Engineer: All designated-design submittals for wind-load-restraint calculations are to be signed and sealed by qualified professional engineer responsible for their preparation.

2. Wind-Load-Restraint Detail Drawing:

    a. Design Analysis: To support selection and arrangement of wind-load restraints. Include calculations of combined tensile and shear loads.
    b. Details: Indicate fabrication and arrangement. Detail attachments of restraints to the restrained items and to the structure. Show attachment locations, methods, and spacings. Identify components, list their strengths, and indicate directions and values of forces transmitted to the structure during wind events. Indicate association with vibration isolation devices.
    c. All delegated-design submittals for wind-restraint detail Drawings are to be signed and sealed by qualified professional engineer responsible for their preparation.

3. Product Listing, Preapproval, and Evaluation Documentation: By UL, showing maximum ratings of restraint items and the basis for approval (tests or calculations).
4. Riser Supports: Include riser diagrams and calculations showing anticipated expansion and contraction at each support point, initial and final loads on building structure. Include certification that riser system was examined for excessive stress and that none exists.

1.4 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Show coordination of vibration isolation and wind-load reinforcement device installation for fire-suppression piping and equipment with other systems and equipment in the vicinity, including other supports and restraints, if any.

B. Qualification Data: For professional engineer.

C. Welding certificates.

D. Field quality-control reports.

E. Wind-Load Performance Certification: Provide special certification for fire-suppression system components subject to high wind exposure and impact damage and designated on Drawings or in the Specifications to require wind-load performance certification.

1. Provide equipment manufacturer's written certification for each designated fire suppression system device, stating that it will remain in place and operable following the design wind event and comply with all requirements of authorities having jurisdiction.
2. Certification must be based on ICC-ES or similar nationally recognized testing standard procedures acceptable to authorities having jurisdiction.
3. The following fire-suppression system systems and components require special certification for high wind performance. Written special certification of resistance to the effects of high wind load and impact damage must be provided by manufacturer.

a. Any equipment exposed to the outdoors.

1.5 QUALITY ASSURANCE

A. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct testing indicated, that is an NRTL as defined by OSHA in 29 CFR 1910.7, and that is acceptable to authorities having jurisdiction.

B. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

C. Wind-Load-Restraint Device Load Ratings: Devices to be tested and rated in accordance with applicable code requirements and authorities having jurisdiction. Devices to be listed by a nationally recognized third party that requires periodic follow-up inspections and has a listing directory available to the public. Provide third-party listing by one or more of the following: UL product listing.

PART 2 - PRODUCTS

2.1 ELASTOMERIC ISOLATION PADS

A. Elastomeric Isolation Pads: ..

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Ace Mountings Co., Inc.

b. CADDY; brand of nVent Electrical plc
c. California Dynamics Corporation
d. Isolation Technology, Inc
e. Kinetics Noise Control, Inc
f. Korfund
g. Mason Industries, Inc.
h. NOVIA; a division of Carpenter & Paterson
i. Vibration Eliminator Co., Inc
j. Vibration Isolation
k. Vibration Management Corp.
l. VMC GROUP

2. Basis-of-Design Product: Subject to compliance with requirements, provide isolation pad or comparable product by one of the following:

a. Ace Mountings Co., Inc.
b. CADDY; brand of nVent Electrical plc
c. California Dynamics Corporation
d. Isolation Technology, Inc
e. Kinetics Noise Control, Inc
f. Korfund
g. Mason Industries, Inc.
h. NOVIA; a division of Carpenter & Paterson
i. Vibration Eliminator Co., Inc
j. Vibration Isolation
k. Vibration Management Corp.
l. VMC GROUP

3. Fabrication: Single or multiple layers of sufficient durometer stiffness for uniform loading over pad area.
4. Size: Factory or field cut to match requirements of supported equipment.
5. Pad Material: Oil and water resistant with elastomeric properties. Neoprene rubber, silicone rubber, or other elastomeric material.
6. Surface Pattern: Smooth, ribbed, or waffle pattern.
7. Infused nonwoven cotton or synthetic fibers.
8. Load-bearing metal plates adhered to pads.
9. Sandwich-Core Material: Resilient and elastomeric.

a. Surface Pattern: Smooth, ribbed, or waffle pattern.
b. Infused nonwoven cotton or synthetic fibers.

2.2 ELASTOMERIC ISOLATION MOUNTS

A. Double-Deflection, Elastomeric Isolation Mounts: ..

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Ace Mountings Co., Inc.

b. CADDY; brand of nVent Electrical plc
c. California Dynamics Corporation
d. Isolation Technology, Inc
e. Kinetics Noise Control, Inc
f. Korfund
g. Mason Industries, Inc.
h. NOVIA; a division of Carpenter & Paterson
i. Vibration Eliminator Co., Inc
j. Vibration Isolation
k. Vibration Management Corp.
l. VMC GROUP

2. Basis-of-Design Product: Subject to compliance with requirements, provide isolation mount or comparable product by one of the following:

a. Ace Mountings Co., Inc.
b. CADDY; brand of nVent Electrical plc
c. California Dynamics Corporation
d. Isolation Technology, Inc
e. Kinetics Noise Control, Inc
f. Korfund
g. Mason Industries, Inc.
h. NOVIA; a division of Carpenter & Paterson
i. Vibration Eliminator Co., Inc
j. Vibration Isolation
k. Vibration Management Corp.
l. VMC GROUP

3. Mounting Plates:

a. Top Plate: Encapsulated steel load transfer top plates, factory drilled and threaded with threaded studs or bolts.
b. Baseplate: Encapsulated steel bottom plates with holes provided for anchoring to support structure.

4. Elastomeric Material: Molded, oil and water resistant neoprene rubber, silicone rubber, or other elastomeric material.

2.3 RESTRAINED ELASTOMERIC ISOLATION MOUNTS

A. Restrained Elastomeric Isolation Mounts: ..

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Ace Mountings Co., Inc.
b. CADDY; brand of nVent Electrical plc
c. California Dynamics Corporation
d. Isolation Technology, Inc

e. Kinetics Noise Control, Inc
f. Korfund
g. Mason Industries, Inc.
h. NOVIA; a division of Carpenter & Paterson
i. Vibration Eliminator Co., Inc
j. Vibration Isolation
k. Vibration Management Corp.
l. VMC GROUP

2. Basis-of-Design Product: Subject to compliance with requirements, provide restrained isolation mount or comparable product by one of the following:

a. Ace Mountings Co., Inc.
b. CADDY; brand of nVent Electrical plc
c. California Dynamics Corporation
d. Isolation Technology, Inc
e. Kinetics Noise Control, Inc
f. Korfund
g. Mason Industries, Inc.
h. NOVIA; a division of Carpenter & Paterson
i. Vibration Eliminator Co., Inc
j. Vibration Isolation
k. Vibration Management Corp.
l. VMC GROUP

3. Description: All-directional isolator with seismic restraints containing two separate and opposing elastomeric elements that prevent central threaded element and attachment hardware from contacting the housing during normal operation.

a. Housing: Cast-ductile iron or welded steel.
b. Elastomeric Material: Molded, oil-resistant rubber, neoprene, or other elastomeric material.

2.4 ELASTOMERIC HANGERS

A. Elastomeric Mount in a Steel Frame with Upper and Lower Steel Hanger Rods: ..

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Ace Mountings Co., Inc.
b. CADDY; brand of nVent Electrical plc
c. California Dynamics Corporation
d. Kinetics Noise Control, Inc
e. Mason Industries, Inc.
f. NOVIA; a division of Carpenter & Paterson
g. Vibration Eliminator Co., Inc
h. Vibration Isolation
i. Vibration Management Corp.

j. VMC GROUP

2. Basis-of-Design Product: Subject to compliance with requirements, provide hanger or comparable product by one of the following:

a. Ace Mountings Co., Inc.
b. CADDY; brand of nVent Electrical plc
c. California Dynamics Corporation
d. Kinetics Noise Control, Inc
e. Mason Industries, Inc.
f. NOVIA; a division of Carpenter & Paterson
g. Vibration Eliminator Co., Inc
h. Vibration Isolation
i. Vibration Management Corp.
j. VMC GROUP

3. Frame: Steel, fabricated with a connection for an upper threaded hanger rod and an opening on the underside to allow for a maximum of 30 degrees of angular lower hanger-rod misalignment without binding or reducing isolation efficiency.
4. Damping Element: Molded, oil-resistant rubber, neoprene, or other elastomeric material with a projecting bushing for the underside opening preventing steel-to-steel contact.

2.5 SNUBBERS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. CADDY; brand of nVent Electrical plc
2. Kinetics Noise Control, Inc
3. Mason Industries, Inc.
4. Vibration Management Corp.
5. VMC GROUP

B. Basis-of-Design Product: Subject to compliance with requirements, provide snubbers or comparable product by one of the following:

1. CADDY; brand of nVent Electrical plc
2. Kinetics Noise Control, Inc
3. Mason Industries, Inc.
4. Vibration Management Corp.
5. VMC GROUP

C. Description: Factory fabricated using welded structural-steel shapes and plates, anchor bolts, and replaceable resilient isolation washers and bushings.

1. Post-Installed Concrete Anchor Bolts: Secure to concrete surface with post-installed concrete anchors. Anchors to be seismically prequalified in accordance with ACI 355.2 testing and designated in accordance with ACI 318-14 Ch. 17 for

2015 or 2018 IBC.
2. Preset Concrete Inserts: Seismically prequalified in accordance with ICC-ES AC446 testing.
3. Anchors in Masonry: Design in accordance with TMS 402.
4. Resilient Isolation Washers and Bushings: Oil- and water-resistant neoprene.
5. Resilient Cushion: Maximum **1/4-inch** air gap, and minimum **1/4 inch** thick.

2.6 RESTRAINTS - RIGID TYPE

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Atkore Unistrut
2. CADDY; brand of nVent Electrical plc
3. California Dynamics Corporation
4. Cooper B-line; brand of Eaton, Electrical Sector
5. Hilti, Inc.
6. Isolation Technology, Inc
7. TOLCO Incorporated
8. VMC GROUP

B. Basis-of-Design Product: Subject to compliance with requirements, provide restraints-rigid type or comparable product by one of the following:

1. Atkore Unistrut
2. CADDY; brand of nVent Electrical plc
3. California Dynamics Corporation
4. Cooper B-line; brand of Eaton, Electrical Sector
5. Hilti, Inc.
6. Isolation Technology, Inc
7. TOLCO Incorporated
8. VMC GROUP

C. Description: Shop- or field-fabricated bracing assembly made of AISI S110-07-S1 slotted steel channels, ANSI/ASTM A53/A53M steel pipe as per NFPA 13, or other rigid steel brace member. Includes accessories for attachment to braced component at one end and to building structure at the other end and other matching components and with corrosion-resistant coating; rated in tension, compression, and torsion forces.

D. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. CADDY; brand of nVent Electrical plc
2. Cooper B-line; brand of Eaton, Electrical Sector
3. Gripple Inc.
4. Loos & Co. Inc.
5. VMC GROUP

E. Basis-of-Design Product: Subject to compliance with requirements, provide restraint or comparable product by one of the following:

1. CADDY; brand of nVent Electrical plc
2. Cooper B-line; brand of Eaton, Electrical Sector
3. Gripple Inc.
4. Loos & Co. Inc.
5. VMC GROUP

F. Restraint cable assembly with cable fittings must comply with ASCE/SEI 19. All cable fittings and complete cable assembly must maintain the minimum cable breaking force. U-shaped cable clips and wedge-type end fittings do not comply and are unacceptable.

G. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Atkore Unistrut
2. CADDY; brand of nVent Electrical plc
3. Cooper B-line; brand of Eaton, Electrical Sector
4. Hilti, Inc.
5. Loos & Co. Inc.
6. Mason Industries, Inc.
7. TOLCO Incorporated

H. Basis-of-Design Product: Subject to compliance with requirements, provide restraint or comparable product by one of the following:

1. Atkore Unistrut
2. CADDY; brand of nVent Electrical plc
3. Cooper B-line; brand of Eaton, Electrical Sector
4. Hilti, Inc.
5. Loos & Co. Inc.
6. Mason Industries, Inc.
7. TOLCO Incorporated

I. Hanger-Rod Stiffener: Steel tube or steel slotted-support-system sleeve with internally bolted connections to hanger rod. Non-metallic stiffeners are unacceptable.

J. Hinged and Swivel Brace Attachments: Multifunctional steel connectors for attaching hangers to rigid channel bracings and restraint cables.

K. Bushings for Floor-Mounted Equipment Anchor Bolts: Neoprene bushings designed for rigid equipment mountings, and matched to type and size of anchor bolts and studs.

L. Bushing Assemblies for Wall-Mounted Equipment Anchorage: Assemblies of neoprene elements and steel sleeves designed for rigid equipment mountings, and matched to type and size of attachment devices used.

M. Resilient Isolation Washers and Bushings: One-piece, molded, oil- and water-resistant neoprene, with a flat washer face.

2.7 POST-INSTALLED CONCRETE ANCHORS

A. Mechanical Anchor Bolts:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

    a. Atkore Unistrut
    b. Cooper B-line; brand of Eaton, Electrical Sector
    c. Hilti, Inc.
    d. Mason Industries, Inc.
    e. Powers Fasteners

2. Basis-of-Design Product: Subject to compliance with requirements, provide anchors or comparable product by one of the following:

    a. Atkore Unistrut
    b. Cooper B-line; brand of Eaton, Electrical Sector
    c. Hilti, Inc.
    d. Mason Industries, Inc.
    e. Powers Fasteners

3. Drilled-in and stud-wedge or female-wedge type in zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with strength required for anchor and as tested according to ASTM E488/E488M.

B. Adhesive Anchor Bolts:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

    a. Atkore Unistrut
    b. Cooper B-line; brand of Eaton, Electrical Sector
    c. Hilti, Inc.
    d. Mason Industries, Inc.
    e. Powers Fasteners

2. Basis-of-Design Product: Subject to compliance with requirements, provide anchor bolt or comparable product by one of the following:

    a. Atkore Unistrut
    b. Cooper B-line; brand of Eaton, Electrical Sector
    c. Hilti, Inc.
    d. Mason Industries, Inc.
    e. Powers Fasteners

3. Drilled-in and capsule anchor system containing PVC or urethane methacrylate-based resin and accelerator, or injected polymer or hybrid mortar adhesive. Provide anchor bolts and hardware with zinc-coated steel for interior applications

and stainless steel for exterior applications. Select anchor bolts with strength required for anchor and as tested according to ASTM E488/E488M.

C. Provide post-installed concrete anchors that have been prequalified for use in wind-load applications.

1. Prequalify post-installed anchors in concrete in accordance with ACI 355.2 or other approved qualification testing procedures.
2. Prequalify post-installed anchors in masonry in accordance with approved qualification procedures.

D. Expansion-type anchor bolts are not permitted for equipment in excess of **10 hp** that is not vibration isolated.

1. Undercut expansion anchors are permitted.

E. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Atkore Unistrut
2. Cooper B-line; brand of Eaton, Electrical Sector
3. Hilti, Inc.
4. Mason Industries, Inc.
5. Powers Fasteners

F. Basis-of-Design Product: Subject to compliance with requirements, provide insert or comparable product by one of the following:

1. Atkore Unistrut
2. Cooper B-line; brand of Eaton, Electrical Sector
3. Hilti, Inc.
4. Mason Industries, Inc.
5. Powers Fasteners

G. Provide preset concrete inserts that are seismically prequalified in accordance with ICC-ES AC466 testing.

H. Comply with ANSI/MSS SP-58.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and equipment to receive vibration isolation and wind-force-restraint devices for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine roughing-in of reinforcement and cast-in-place anchors to verify actual locations before installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 APPLICATIONS

A. Multiple Pipe Supports: Secure pipes to trapeze member with clamps approved for application by an agency acceptable to authorities having jurisdiction.

B. Hanger-Rod Stiffeners: Install where indicated or scheduled on Drawings to receive them and where required to prevent buckling of hanger rods due to high wind forces.

C. Strength of Support and Restraint Assemblies: Where not indicated, select sizes of components so strength is adequate to carry static and wind load within specified loading limits.

3.3 INSTALLATION OF VIBRATION-CONTROL AND WIND-LOAD-RESTRAINT DEVICES

A. Provide vibration-control devices for systems and equipment where indicated in Equipment Schedules or Fire-Suppression Vibration Isolation and Wind-Load-Restraints Schedule, where indicated on Drawings, or where the Specifications indicate they are to be installed on specific equipment and systems.

B. Provide wind-load-restraint devices for systems and equipment where indicated in Equipment Schedules or Vibration Isolation and Wind-Load-Restraints Schedules, where indicated on Drawings, where the Specifications indicate they are to be installed on specific equipment and systems, and where required by applicable codes.

C. Coordinate location of embedded connection hardware with supported equipment attachment and mounting points and with requirements for concrete reinforcement and formwork specified in Section 033000 "Cast-in-Place Concrete."

D. Installation of vibration isolators and wind-load restraints must not cause any stresses, misalignment, or change of position of equipment or piping.

E. Comply with requirements in Section 077200 "Roof Accessories" for installation of equipment supports and roof penetrations.

F. Equipment Restraints:

1. Install snubbers on fire-suppression equipment mounted on vibration isolators. Locate snubbers as close as possible to vibration isolators and bolt to equipment base and supporting structure.
2. Install resilient bolt isolation washers on equipment anchor bolts where clearance between anchor and adjacent surface exceeds **0.125 inch**.

G. Piping Restraints:

1. Comply with all requirements in NFPA 13.
2. Design piping sway bracing according to NFPA 13.

a. Maximum spacing of all sway bracing to be no greater than indicated in NFPA 13.
b. Design loading of all sway bracing not to exceed values indicated in NFPA 13.

H. Install wind-load-restraint devices using methods approved by an evaluation service member of ICC-ES that provides required submittals for component.

I. Install bushing assemblies for anchor bolts for floor-mounted equipment, arranged to provide resilient media between anchor bolt and mounting hole in concrete base.

J. Install bushing assemblies for mounting bolts for wall-mounted equipment, arranged to provide resilient media where equipment or equipment-mounting channels are attached to wall.

K. Attachment to Structure: If specific attachment is not indicated, anchor bracing to structure at flanges of beams, at upper truss chords of bar joists, or at concrete members.

L. Post-Installed Concrete Anchors:

1. Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Do not damage existing reinforcing or embedded items during coring or drilling. Notify the structural engineer if reinforcing steel or other embedded items are encountered during drilling. Locate and avoid prestressed tendons, electrical and telecommunications conduit, and gas lines.
2. Do not drill holes in concrete or masonry until concrete, mortar, or grout has achieved full design strength.
3. Mechanical-Type Anchor Bolts: Protect threads from damage during anchor installation. Heavy-duty sleeve anchors shall be installed with sleeve fully engaged in the structural element to which anchor is to be fastened.
4. Adhesive-Type Anchor Bolts: Clean holes to remove loose material and drilling dust prior to installation of adhesive. Place adhesive in holes proceeding from the bottom of the hole and progressing toward the surface in such a manner as to avoid introduction of air pockets in the adhesive.
5. Set anchors to manufacturer's recommended torque, using a torque wrench.
6. Install zinc-coated steel anchors for interior and stainless steel anchors for exterior applications.

3.4 ACCOMMODATION OF DIFFERENTIAL STRUCTURAL MOTION

A. Install flexible connections in piping where they cross structural construction joints and other points where differential movement may occur, where adjacent sections or branches are supported by different structural elements, and where the connections terminate with connection to equipment that is anchored to a different structural element from the one supporting the connections as they approach equipment. Comply with requirements in Section 211000 "Water-Based Fire-Suppression Systems" for piping flexible connections.

3.5 ADJUSTING

A. Adjust isolators after system is at operating weight.

B. Adjust limit stops on restrained-spring isolators to mount equipment at normal operating height. After equipment installation is complete, adjust limit stops so they are out of contact during normal operation.

3.6 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

C. Tests and Inspections:

1. Provide evidence of recent calibration of test equipment by a testing agency acceptable to authorities having jurisdiction.
2. Schedule test with Owner, through Architect, before connecting anchorage device to restrained component (unless postconnection testing has been approved), and with at least seven days' advance notice.
3. Obtain Architect's approval before transmitting test loads to structure. Provide temporary load-spreading members.
4. Test at no fewer than four of each type and size of installed anchors and fasteners selected by Architect.
5. Test to 90 percent of rated proof load of device.
6. Measure isolator restraint clearance.
7. Measure isolator deflection.
8. Verify snubber minimum clearances.

D. Remove and replace malfunctioning units and retest as specified above.

E. Units will be considered defective if they do not pass tests and inspections.

F. Prepare test and inspection reports.

END OF SECTION 21 05 48.13

SECTION 21 05 53 - IDENTIFICATION FOR FIRE-SUPPRESSION PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Equipment labels.
2. Warning signs and labels.
3. Warning tape
4. Pipe labels.
5. Stencils.
6. Valve tags.
7. Warning tags.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Samples: For color, letter style, and graphic representation required for each identification material and device.

C. Equipment-Label Schedule: Include a listing of all equipment to be labeled and the proposed content for each label.

D. Valve-numbering scheme.

E. Valve Schedules: Provide for fire-suppression piping system. Include in operation and maintenance manuals.

PART 2 - PRODUCTS

2.1 EQUIPMENT LABELS

A. Plastic Labels for Equipment:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Brady Corporation
b. Carlton Industries, LP
c. Champion America
d. Craftmark Pipe Markers
e. emedco

f. Kolbi Pipe Marker Co.
g. LEM Products Inc.
h. Marking Services Inc.
i. Pipemarker.com; Brimar Industries, Inc.
j. Seton Identification Products; a Brady Corporation company

2. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch thick, with predrilled holes for attachment hardware.
3. Letter and Background Color: As indicated for specific application under Part 3.
4. Maximum Temperature: Able to withstand temperatures of up to **160 deg F**.
5. Minimum Label Size: Length and width vary for required label content, but not less than **2-1/2 by 3/4 inch**.
6. Minimum Letter Size: **1/4 inch** for name of units if viewing distance is less than **24 inches**, **1/2 inch** for viewing distances of up to **72 inches**, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
7. Fasteners: Stainless steel rivets or self-tapping screws.
8. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

B. Label Content: Include equipment's Drawing designation or unique equipment number, Drawing numbers where equipment is indicated (plans, details, and schedules), and the Specification Section number and title where equipment is specified.

2.2 WARNING SIGNS AND LABELS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Brady Corporation
2. Carlton Industries, LP
3. Champion America
4. Craftmark Pipe Markers
5. emedco
6. LEM Products Inc.
7. Marking Services Inc.
8. National Marker Company
9. Pipemarker.com; Brimar Industries, Inc.
10. Seton Identification Products; a Brady Corporation company
11. Stranco, Inc.

B. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch thick, with predrilled holes for attachment hardware.

C. Letter and Background Color: As indicated for specific application under Part 3.

D. Maximum Temperature: Able to withstand temperatures of up to **160 deg F**.

E. Minimum Label Size: Length and width vary for required label content, but not less than

2-1/2 by 3/4 inch.

F. Minimum Letter Size: **1/4 inch** for name of units if viewing distance is less than **24 inches**, **1/2 inch** for viewing distances of up to **72 inches**, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.

G. Fasteners: Stainless steel rivets or self-tapping screws.

H. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

I. Arc-Flash Warning Signs: Provide arc-flash warning signs in locations and with content in accordance with requirements of OSHA and NFPA 70E , and other applicable codes and standards.

J. Label Content: Include caution and warning information, plus emergency notification instructions.

2.3 WARNING TAPE

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Brady Corporation
2. Craftmark Pipe Markers
3. National Marker Company
4. Pipemarker.com; Brimar Industries, Inc.
5. Seton Identification Products; a Brady Corporation company

B. Material: Vinyl.

C. Minimum Thickness: **0.005 inch**.

D. Letter, Pattern, and Background Color: As indicated for specific application under Part 3.

E. Waterproof Adhesive Backing: Suitable for indoor or outdoor use.

F. Maximum Temperature: **160 deg F**.

G. Minimum Width: 2 inches.

2.4 PIPE LABELS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Actioncraft Products, Inc.; a division of Industrial Test Equipment Co., Inc.

2. Brady Corporation
3. Carlton Industries, LP
4. Champion America
5. Craftmark Pipe Markers
6. emedco
7. Kolbi Pipe Marker Co.
8. LEM Products Inc.
9. Marking Services Inc.
10. Pipemarker.com; Brimar Industries, Inc.
11. Seton Identification Products; a Brady Corporation company

B. General Requirements for Manufactured Pipe Labels: Preprinted, color coded, with lettering indicating service and showing flow direction in accordance with ASME A13.1.

C. Letter and Background Color: As indicated for specific application under Part 3.

D. Pretensioned Pipe Labels: Precoiled, semirigid plastic formed to cover full circumference of pipe and to attach to pipe without fasteners or adhesive.

E. Self-Adhesive Pipe Labels: Printed plastic with contact-type, permanent-adhesive backing.

F. Pipe-Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings. Also include the following:

1. Pipe size.
2. Flow-Direction Arrows: Include flow-direction arrows on main distribution piping. Arrows may be either integral with label or applied separately.
3. Lettering Size: Size letters in accordance with ASME A13.1 for piping.

2.5 STENCILS

A. Stencils for Piping:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

    a. Craftmark Pipe Markers
    b. Kolbi Pipe Marker Co.
    c. Marking Services Inc.
    d. Pipemarker.com; Brimar Industries, Inc.

2. Lettering Size: Size letters in accordance with ASME A13.1 for piping.
3. Stencil Material: Aluminum, brass, or fiberboard.
4. Stencil Paint: Exterior, gloss, acrylic enamel. Paint may be in pressurized spray-can form.
5. Identification Paint: Exterior, acrylic enamel. Paint may be in pressurized spray-can form.
6. Letter and Background Color: As indicated for specific application under Part 3.

2.6 VALVE TAGS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Actioncraft Products, Inc.; a division of Industrial Test Equipment Co., Inc.
2. Brady Corporation
3. Carlton Industries, LP
4. Champion America
5. Craftmark Pipe Markers
6. emedco
7. Kolbi Pipe Marker Co.
8. LEM Products Inc.
9. Marking Services Inc.
10. Pipemarker.com; Brimar Industries, Inc.
11. Seton Identification Products; a Brady Corporation company

B. Description: Stamped or engraved with **1/4-inch** letters for piping-system abbreviation and **1/2-inch** numbers.

1. Tag Material: Brass, 0.04 inch thick, with predrilled or stamped holes for attachment hardware.
2. Fasteners: Brass link chain beaded chain or S-hook.

C. Letter and Background Color: As indicated for specific application under Part 3.

D. Valve Schedules: For each piping system, on **8-1/2-by-11-inch** bond paper. Tabulate valve number, piping system, system abbreviation (as shown on valve tag), location of valve (room or space), normal operating position (open, closed, or modulating), and variations for identification. Mark valves for emergency shutoff and similar special uses.

1. Include valve-tag schedule in operation and maintenance data.

2.7 WARNING TAGS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Brady Corporation
2. Champion America
3. Craftmark Pipe Markers
4. emedco
5. Kolbi Pipe Marker Co.
6. LEM Products Inc.
7. Marking Services Inc.
8. Pipemarker.com; Brimar Industries, Inc.
9. Seton Identification Products; a Brady Corporation company

B. Description: Preprinted accident-prevention tags, of plasticized card stock with matte finish suitable for writing.

1. Size: 3 by 5-1/4 inches minimum.
2. Fasteners: Brass grommet and wire.
3. Nomenclature: Large-size primary caption, such as "DANGER," "CAUTION," or "DO NOT OPERATE."
4. Letter and Background Color: As indicated for specific application under Part 3.

PART 3 - EXECUTION

3.1 PREPARATION

A. Clean piping and equipment surfaces of incompatible primers, paints, and encapsulants, as well as dirt, oil, grease, release agents, and other substances that could impair bond of identification devices.

3.2 INSTALLATION GENERAL REQUIREMENTS

A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be installed.

B. Coordinate installation of identifying devices with locations of access panels and doors.

C. Install identifying devices before installing acoustical ceilings and similar concealment.

D. Locate identifying devices so that they are readily visible from the point of normal approach.

3.3 INSTALLATION OF EQUIPMENT LABELS, WARNING SIGNS, AND LABELS

A. Permanently fasten labels on each item of fire-suppression equipment.

B. Sign and Label Colors:

1. White letters on an ANSI Z535.1 safety-red background.

C. Locate equipment labels where accessible and visible.

D. Arc-Flash Warning Signs: Provide arc-flash warning signs on electrical disconnects and other equipment where arc-flash hazard exists, as indicated on Drawings, and in accordance with requirements of OSHA and NFPA 70E , and other applicable codes and standards.

3.4 INSTALLATION OF WARNING TAPE

A. Warning Tape Color and Pattern: Yellow background with black diagonal stripes.

B. Install warning tape on pipes and ducts, with cross-designated walkways providing less than **6 ft.** of clearance.

C. Locate tape so as to be readily visible from the point of normal approach.

3.5 INSTALLATION OF PIPE LABELS

A. Piping Color Coding: Painting of piping is specified in Section 099123 "Interior Painting."

B. Install pipe labels showing service and flow direction with permanent adhesive on pipes.

C. Stenciled Pipe-Label Option: Stenciled labels showing service and flow direction may be provided instead of manufactured pipe labels, at Installer's option. Install stenciled pipe labels, complying with ASME A13.1, with painted, color-coded bands or rectangles on each piping system.

1. Identification Paint: Use for contrasting background.
2. Stencil Paint: Use for pipe marking.

D. Pipe-Label Locations: Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior exposed locations as follows:

1. Within **3 ft.** of each valve and control device.
2. At access doors, manholes, and similar access points that permit a view of concealed piping.
3. Within **3 ft.** of equipment items and other points of origination and termination.
4. Spaced at maximum intervals of 25 ft. along each run. Reduce intervals to 10 ft. in areas of congested piping and equipment.

E. Flow- Direction Arrows: Provide arrows to indicate direction of flow in pipes, including pipes where flow is allowed in both directions.

F. Fire-Suppression Pipe Label Color Schedule:

1. Fire-Suppression Pipe Labels: White letters on an ANSI Z535.1 safety-red background.

3.6 INSTALLATION OF VALVE TAGS

A. Install tags on valves and control devices in fire-suppression piping systems. List tagged valves in a valve-tag schedule in the operating and maintenance manual. Include the identification "FSV" on all fire-suppression system valve tags.

B. Valve-Tag Application Schedule: Tag valves according to size, shape, and with captions similar to those indicated in "Valve-Tag Size and Shape" Subparagraph below.

1. Valve-Tag Size and Shape:

    a. Fire-Suppression Standpipe: 2 inches, round.
    b. Wet-Pipe Sprinkler System: 2 inches, round.
    c. Dry-Pipe Sprinkler System: 2 inches, round.
    d. Foam-Water System: 2 inches, round.
    e. Clean-Agent Fire-Extinguishing System: 2 inches, round.
    f. Preaction System: 2 inches, round.

2. Valve-Tag Color: White letters on an ANSI Z535.1 safety-red background.

3.7 INSTALLATION OF WARNING TAGS

A. Warning Tag Color: Black letters on an ANSI Z535.1 safety-yellow background.

B. Attach warning tags, with proper message, to equipment and other items where indicated on Drawings.

END OF SECTION 21 05 53

SECTION 21 10 00 - WATER-BASED FIRE-SUPPRESSION SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Fire-suppression piping, fittings, and appurtenances.
2. Fire department connections.
3. Hose connections and hose stations.
4. System control valves.
5. Fire-suppression piping specialties.
6. Sprinklers.
7. Alarm devices.
8. Manual control stations.
9. Control panels.

B. Related Requirements:

1. Section 331415 "Site Water Distribution Piping" for site fire-suppression water-service and backflow prevention devices.

1.2 DEFINITIONS

A. Standard-Pressure Fire-Suppression System Piping: Piping designed to operate at working pressure of **175 psig** maximum.

B. High-Pressure Fire-Suppression System Piping: Piping designed to operate at working pressure higher than standard **175 psig**, but not higher than 250 psig.

1.3 ACTION SUBMITTALS

A. Product Data:

1. For each type of product.

a. Include construction details, material descriptions, dimensions of individual components and profiles.
b. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

B. Sustainable Design Submittals:

C. Shop Drawings:

1. Prepare in accordance with NFPA 13 section "Working Plans."

a. Include plans, elevations, and sections of the system piping and details.
b. Include detailed riser diagram and schematic diagram showing system supply, supply connection, devices, valves, pipe and fittings, as well as the delineation of the standard-pressure and high-pressure portions of the fire-suppression system.
c. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.

2. Prepare computer-generated hydraulic calculations in accordance with the following:

a. Minimum operating pressure at hydraulically most remote fire hose valve is to be 100 psig.
b. Name of hydraulic program used.
c. Water supply information, including fire hydrant flow test data report.

3. Submit documents and calculations signed and sealed by qualified professional engineer responsible for their preparation
4. Include diagrams for power, signal, and control wiring.

D. Delegated Design Submittals: For fire-suppression systems indicated to comply with performance requirements and design criteria, including analysis data, signed and sealed by the qualified professional engineer responsible for their preparation.

1.4 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Fire-suppression system plans and sections, or Building Information Model (BIM), drawn to scale, showing the items described in this Section and coordinated with all building trades.

B. Seismic Qualification Certificates: For fire-suppression equipment, accessories, and components, from manufacturer.

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

C. Qualification Data: For qualified Installer and professional engineer and NICET-certified technician.

D. Design Data: Approved fire-suppression piping working plans, prepared in accordance with NFPA 13, including documented approval by AHJs, and including hydraulic calculations if applicable.

E. Welding certificates.

F. Field Test Reports:

1. Indicate and interpret test results for compliance with performance requirements and as described in NFPA 13. Include "Contractor's Material and Test Certificate for Aboveground Piping."
2. Fire-hydrant flow test report.

G. Field quality-control reports.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For fire-suppression systems and specialties to include in emergency, operation, and maintenance manuals.

1.6 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Sprinkler Cabinets: Finished, wall-mounted, steel cabinet with hinged cover, and with space for minimum of six spare sprinklers plus sprinkler wrench. Include number of sprinklers required by NFPA 13 and sprinkler wrench. Include separate cabinet with sprinklers and wrench for each type of sprinkler used on Project.
2. System control valves.

1.7 QUALITY ASSURANCE

A. Installer Qualifications:

1. Installer's responsibilities include designing, fabricating, and installing fire-suppression systems and providing professional engineering services needed to assume engineering responsibility. Base calculations on results of fire-hydrant flow test.

a. Engineering Responsibility: Preparation of working plans, calculations, and field test reports by qualified professional engineer.

B. Welding Qualifications: Qualify procedures and operators in accordance with ASME Boiler and Pressure Vessel Code.

1.8 FIELD CONDITIONS

A. Interruption of Existing Fire-Suppression Service: Do not interrupt fire-suppression service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary fire-suppression service in accordance with requirements indicated:

1. Notify Architect no fewer than seven days in advance of proposed interruption of fire-suppression service.

2. Do not proceed with interruption of fire-suppression service without Architect's written permission.

PART 2 - PRODUCTS

2.1 SYSTEM DESCRIPTION

A. Automatic wet-type, Class III standpipe system.

B. Automatic dry-type, Class III standpipe system.

C. Semiautomatic dry-type, Class III standpipe system.

D. Manual wet-type, Class I standpipe system.

E. Manual dry-type, Class I standpipe system.

F. Automatic combination wet-type standpipe sprinkler system.

G. Automatic wet-pipe sprinkler system.

H. Automatic dry-pipe sprinkler.

I. Automatic deluge sprinkler system.

J. Automatic single-interlock preaction sprinkler system.

K. Automatic double-interlock preaction sprinkler system.

2.2 PERFORMANCE REQUIREMENTS

A. Seismic Performance: Fire-suppression system piping to withstand the effects of earthquake motions determined in accordance with NFPA 13. See Section 210548 "Vibration and Seismic Controls for Fire-Suppression Piping and Equipment."

B. Fire-Suppression System Components, Devices, and Accessories: Listed in ULSE's "Fire Protection Equipment Directory" and FM Approvals' "Approval Guide."

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

D. Fire-suppression system equipment, specialties, accessories, installation, and testing to comply with NFPA 13 NFPA 13R.

E. Standard-Pressure Piping System Component: Listed for **175 psig** minimum working pressure.

F. High-Pressure Piping System Component: Listed for 250 psig minimum working

pressure.

G. Delegated Design: Engage a qualified professional engineer to design fire-suppression systems.

1. Fire-Hydrant Flow Test:

   a. Perform fire-hydrant flow test and record the following conditions:

      1) Date: ..
      2) Time: .
      3) Performed by: . of ..
      4) Location of Residual Fire Hydrant R: ..
      5) Location of Flow Fire Hydrant F: ..
      6) Static Pressure at Residual Fire Hydrant R: ..
      7) Measured Flow at Flow Fire Hydrant F: ..
      8) Residual Pressure at Residual Fire Hydrant R: ..

   b. Fire-hydrant flow test must be performed within previous 6 months prior to completion of design documents and hydraulic calculations.

2. Margin of Safety for Available Water Flow and Pressure: 10 percent, including losses through water-service piping, valves, and backflow preventers.
3. Sprinkler Occupancy Hazard Classifications:

   a. Electrical Equipment Rooms: Ordinary Hazard, Group 1.
   b. Elevator Machine Room and Hoistway: Ordinary Hazard, Group 1.
   c. General Storage Areas: Ordinary Hazard, Group 1.
   d. Mechanical Equipment Rooms: Ordinary Hazard, Group 1.
   e. Mercantile: Ordinary Hazard, Group 2.
   f. Offices, including Data Processing: Light Hazard.
   g. Residential: Light Hazard.
   h. Restaurant Service Areas: Ordinary Hazard, Group 1.

4. Minimum Density for Automatic-Sprinkler Piping Design:

   a. Residential (Dwelling) Occupancy: 0.05 gpm/sq. ft. over 400 sq. ft. area.
   b. Light-Hazard Occupancy: 0.10 gpm/sq. ft. over 1500 sq. ft. area.
   c. Ordinary-Hazard, Group 1 Occupancy: 0.15 gpm/sq. ft. over 1500 sq. ft. area.
   d. Ordinary-Hazard, Group 2 Occupancy: 0.20 gpm/sq. ft. over 1500 sq. ft. area.

5. Minimum Density for Deluge-Sprinkler Piping Design:

   a. Ordinary-Hazard, Group 1 Occupancy: 0.15 gpm/sq. ft. over entire area.
   b. Ordinary-Hazard, Group 2 Occupancy: 0.20 gpm/sq. ft. over entire area.

6. Maximum protection area per sprinkler in accordance with ULSE listing.
7. Maximum Protection Area per Sprinkler:

a. Residential Areas: 400 sq. ft..
b. Office Spaces: 120 sq. ft..
c. Storage Areas: 130 sq. ft..
d. Mechanical Equipment Rooms: 130 sq. ft..
e. Electrical Equipment Rooms: 130 sq. ft..
f. Other Areas: In accordance with NFPA 13 NFPA 13R recommendations unless otherwise indicated.

8. Total Combined Hose-Stream Demand Requirement: In accordance with NFPA 13 unless otherwise indicated:

a. Light-Hazard Occupancies: 100 gpm for 30 minutes.
b. Ordinary-Hazard Occupancies: 250 gpm for 60 to 90 minutes.

9. Minimum residual pressure at each hose-connection outlet is as follows:

a. NPS 1-1/2 (DN 40) Hose Connections: 65 psig.
b. NPS 2-1/2 (DN 65) Hose Connections: 100 psig.

H. Obtain documented approval of fire-suppression system design from AHJs.

2.3 FIRE-SUPPRESSION PIPING, FITTINGS, AND APPURTENANCES

A. Steel Pipe, Fittings, and Appurtenances:

1. Schedule 40 Steel Pipe: Galvanized- and black- steel pipe, ASTM A53/A53M, ASTM A135/A135M, or ASTM A795/A795M.

a. Standards:

1) UL 852.

b. Factory-applied exterior coating.
c. Factory-applied bacterial-resistant internal coating to reduce microbiologically influenced corrosion.
d. Pipe ends may be factory or field formed to match joining method.

2. Schedule 10 Steel Pipe: Galvanized- and black- steel pipe, ASTM A53/A53M, ASTM A135/A135M, or ASTM A795/A795M.

a. Standards:

1) UL 852.

b. Factory-applied exterior coating.
c. Factory-applied bacterial resistant internal coating to reduce microbiologically influenced corrosion.
d. Pipe ends may be factory or field formed to match joining method.

3. Engineered Light-Wall Steel Pipe: Galvanized- and black- steel pipe, ASTM A135/A135M or ASTM A795/A795M with wall thickness less than Schedule 40.

Outside dimension is to be equivalent to Schedule 40.

a. Standards:

1) UL 852.

b. Factory-applied exterior coating.
c. Factory-applied bacterial-resistant internal coating to reduce microbiologically influenced corrosion.
d. Pipe ends may be factory or field formed to match joining method.

4. Steel Pipe Nipples: Galvanized and black steel, ASTM A733, made of ASTM A53/A53M, standard-weight, seamless steel pipe with threaded ends.
5. Steel Couplings: Galvanized and uncoated steel, ASTM A865/A865M, threaded.
6. Gray-Iron Threaded Fittings: Galvanized and uncoated gray-iron threaded fittings, ASME B16.4, Class 125, standard pattern.
7. Malleable- or Ductile-Iron Unions: ASME B16.3.
8. Cast-Iron Flanges: ASME B16.1, Class 125.
9. Steel Flanges and Flanged Fittings: ASME B16.5, Class 150.

a. Pipe-Flange Gasket Materials: AWWA C110, rubber, flat face, 1/8 inch thick ASME B16.21, nonmetallic and asbestos free or EPDM rubber gasket.

1) Class 125 and Class 250, Cast-Iron, Flat-Face Flanges: Full-face gaskets.
2) Class 150 and Class 300, Ductile-Iron or -Steel, Raised-Face Flanges: Ring-type gaskets.

b. Metal, Pipe-Flange Bolts and Nuts: ASME B18.2.1 carbon steel unless otherwise indicated.

10. Steel Welding Fittings: ASTM A234/A234M and ASME B16.9.

a. Welding Filler Metals: Comply with AWS D10.12M/D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

11. Plain-End-Pipe Fittings:

a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1) Gruvlok; an ASC Engineered Solution
2) Shurjoint; a part of Aalberts Integrated Piping Systems
3) Victaulic Company

b. Pressure Rating: 250 psig minimum.
c. Plain-End Fittings for Steel Piping: Galvanized plain-end fittings, ASTM A53/A53M, carbon steel or ASTM A106/A106M, forged steel with

dimensions matching steel pipe.

d. Plain-End-Pipe Couplings for Steel Piping: Rigid pattern for steel-pipe dimensions, ductile-iron or malleable-iron housing. Include EPDM-rubber gasket, and bolts and nuts.

12. Grooved-Joint, Steel-Pipe Appurtenances:

    a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

        1) CPS Products, Inc.
        2) Gruvlok; an ASC Engineered Solution
        3) SCI; an ASC Engineered Solution
        4) Shurjoint; a part of Aalberts Integrated Piping Systems
        5) SPF/Anvil; an ASC Engineered Solution
        6) Tyco Fire Products; brand of Johnson Controls International plc, Building Solutions North America
        7) Victaulic Company

    b. Pressure Rating: 250 psig minimum.
    c. Grooved-End Fittings for Steel Piping: Galvanized grooved-end fittings, ASTM A47/A47M, malleable-iron casting or ASTM A536, ductile-iron casting, with dimensions matching steel pipe.
    d. Grooved-End-Pipe Couplings for Steel Piping: AWWA C606 and UL 213 rigid pattern, unless otherwise indicated, for steel-pipe dimensions. Include ferrous housing sections, EPDM-rubber gasket, and bolts and nuts.

13. Carbon Steel Pressure-Seal Fittings: UL 213, FM Approvals-approved, **175 psig** pressure rating with carbon steel-, zinc-nickel-coated housing, EDPM O-rings, and pipe stop; for use with fitting manufacturers' pressure-seal tools.

    a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

        1) Mueller Streamline Co.; a company of Mueller Industries
        2) Viega LLC

B. Stainless Steel Pipe, Fittings, and Appurtenances:

1. Stainless Steel Pipe: ASTM A312/A312M, Type 304/304L, Schedule 10S, dimensions conforming to ASME B36.19M.
2. Stainless Steel Pipe Fittings: ASTM A403/A403M.
3. Fittings for Grooved-End, Stainless Steel Pipe:

    a. Manufacturers: Subject to compliance with requirements, provide products by the following:

        1) GroovJoint

b. Source Limitations: Obtain appurtenance for grooved-end, stainless steel pipe from single manufacturer.
c. Standards: ASTM A743; ASTM A193/A193M, Class 2; and ASTM A194/A194M, Type 304, Grade 8M.
d. Fittings for Grooved-End, Stainless Steel Pipe: Stainless steel casting with dimensions matching stainless steel pipe.

4. Mechanical Couplings for Grooved-End, Stainless Steel Pipe:

a. Manufacturers: Subject to compliance with requirements, provide products by the following:

1) GroovJoint

b. AWWA C606 for stainless steel pipe dimensions.
c. Stainless steel housing sections.
d. Stainless steel bolts and nuts.
e. EPDM-rubber gaskets suitable for hot and cold water.
f. Minimum Pressure Rating:

1) NPS 8 (DN 200) and Smaller: 600 psig.
2) NPS 10 and NPS 12 (DN 250 to DN 300): 400 psig.
3) NPS 14 to NPS 24 (DN 350 to DN 600): 250 psig.

C. Copper Tube, Fittings, and Appurtenances:

1. Copper Tube, Drawn Temper: ASTM B88, Type K.
2. Solder-Joint Fittings, Cast Copper: ASME B16.18 pressure fittings.
3. Solder-Joint Fittings, Wrought Copper: ASME B16.22 pressure fittings.
4. Bronze Flanges: ASME B16.24, Class 150, with solder-joint ends.
5. Unions, Cast Copper: MSS SP-123, cast-copper-alloy, hexagonal-stock body, with ball-and-socket, metal-to-metal seating surfaces and solder-joint or threaded ends.
6. Brazing Filler Metals: AWS A5.8/A5.8M, BCuP Series, copper-phosphorus alloys for general-duty brazing unless otherwise indicated.
7. Grooved, Mechanical-Joint, Copper-Tube Appurtenances:

a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1) Gruvlok; an ASC Engineered Solution
2) Shurjoint; a part of Aalberts Integrated Piping Systems
3) Victaulic Company

b. Standard: UL 213.
c. Grooved-End Copper Fittings: ASTM B75/B75M copper tube or ASTM B584 bronze castings.
d. Grooved-End-Tube Couplings: To fit copper tube dimensions; rigid pattern unless otherwise indicated; gasketed fitting EPDM-rubber gasket rated for minimum 180 deg F for use with ferrous housing and steel bolts and nuts;

300 psig minimum CWP pressure rating.

D. CPVC Pipe, Fittings, and Appurtenances:

1. CPVC Pipe: ASTM F442/F442M and UL 1821, SDR 13.5, for **175 psig** rated pressure at **150 deg F**, with plain ends. Include "LISTED" and "CPVC SPRINKLER PIPE" markings.
2. CPVC Fittings: UL listed, for **175 psig** rated pressure at **150 deg F**, socket type. Include "LISTED" and "CPVC SPRINKLER FITTING" markings.

    a. NPS 3/4 to NPS 1-1/2 (DN 20 to DN 40): ASTM F438 and UL 1821, Schedule 40, socket type.
    b. NPS 2 to NPS 3 (DN 50 to DN 80): ASTM F439 and UL 1821, Schedule 80, socket type.
    c. CPVC-to-Metal Transition Fittings: CPVC, one piece, with dimensions equivalent to pipe; one end with threaded brass insert, and one socket end.
    d. CPVC-to-Metal Transition Unions: CPVC, with dimensions equivalent to pipe; one end with threaded brass insert, and one socket end.
    e. Flanges: CPVC, one or two pieces.

3. Solvent Cements for Joining CPVC Piping and Tubing: ASTM F493 solvent cement recommended by pipe and fitting manufacturer, and made for joining CPVC sprinkler pipe and fittings. Include cleaner or primer recommended by pipe and fitting manufacturer.
4. Plastic Pipe-Flange Gasket and Bolts and Nuts: Type and material recommended by piping system manufacturer unless otherwise indicated.

2.4 FIRE DEPARTMENT CONNECTIONS

A. Fire Department Connection, Exposed Type:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

    a. Croker; a Division of Morris Group International
    b. Elkhart Brass Mfg. Co., Inc
    c. Fire Protection Products Inc (FPPI); a brand of Anvil International and Smith-Cooper International
    d. Guardian Fire Equipment, Inc
    e. Potter Roemer LLC; a Division of Morris Group International
    f. Wilson & Cousins Inc.

2. Standard: UL 405.
3. Description: Exposed, projecting, for wall mounting.
4. Pressure Rating: **175 psig** minimum.
5. Body Material: Corrosion-resistant metal.
6. Inlets: Brass with threads in accordance with NFPA 1963 and matching local fire department sizes and threads. Include extension pipe nipples, brass lugged swivel connections, and check devices or clappers.

7. Caps: Brass, lugged type, with gasket and chain.
8. Escutcheon Plate: Round, brass, wall type.
9. Outlet: Back, with pipe threads.
10. Number of Inlets: Two.
11. Escutcheon Plate Marking: "AUTO SPKR".
12. Finish: Polished chrome plated.
13. Outlet Size: NPS 4.

2.5 HOSE CONNECTIONS AND HOSE STATIONS

A. Hose Connections, Adjustable Valve:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

    a. Brooks Equipment Co., Inc
    b. Croker; a Division of Morris Group International
    c. Elkhart Brass Mfg. Co., Inc
    d. Guardian Fire Equipment, Inc
    e. Potter Roemer LLC; a Division of Morris Group International
    f. Wilson & Cousins Inc.
    g. Zurn Industries, LLC

2. Standards:

    a. UL 668.
    b. UL 1468.

3. Description: Fire hose valve, with integral reducing or restricting pressure-control device, for connecting fire hose.
4. Pressure Rating: **175 psig** maximum inlet.
5. Material: Brass or bronze.
6. Size: **NPS 1-1/2 or NPS 2-1/2**, as indicated.
7. Inlet: Female pipe threads.
8. Outlet: Male hose threads with lugged cap, gasket, and chain. Include hose valve threads in accordance with NFPA 1963 and matching local fire department threads.
9. Pattern: Angle or gate.
10. Pressure-Control Device Type: Pressure reducing.
11. Finish: Polished chrome plated.

2.6 SYSTEM CONTROL VALVES

A. Listed in ULSE's "Fire Protection Equipment Directory" or FM Approvals' "Approval Guide."

B. Pressure Rating:

1. Standard-Pressure Piping Valves: **175 psig** minimum.
2. High-Pressure Piping Valves: 250 psig minimum.

C. Body Material: Cast or ductile iron.

D. Size: Same as connected piping.

E. End Connections: Flanged or grooved.

F. System Control Valve, Alarm Valve:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

    a. Reliable Automatic Sprinkler Co., Inc. (The)
    b. Tyco Fire Products; brand of Johnson Controls International plc, Building Solutions North America
    c. Venus Fire Protection Ltd.
    d. Victaulic Company
    e. Viking Group Inc.

2. Standard: UL 193.
3. Design: For horizontal or vertical installation.
4. Include trim sets for bypass, drain, electrical sprinkler alarm switch, pressure gauges, retarding chamber, and fill-line attachment with strainer.
5. Drip cup assembly pipe drain with check valve to main drain piping.

G. System Control Valve, Dry-Pipe Valve:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

    a. Reliable Automatic Sprinkler Co., Inc. (The)
    b. Tyco Fire Products; brand of Johnson Controls International plc, Building Solutions North America
    c. Venus Fire Protection Ltd.
    d. Victaulic Company
    e. Viking Group Inc.

2. Standards:

    a. UL 260.
    b. UL 1486.

3. Design: Differential-pressure type.
4. Include quick-opening devices, trim sets for air supply, drain, priming level, alarm connections, ball drip valves, pressure gauges, priming chamber attachment, and fill-line attachment.

2.7 MANUAL CONTROL STATIONS

A. Listed in ULSE's "Fire Protection Equipment Directory" or FM Approvals' "Approval Guide"

B. Description: For hydraulic operation, with union, **NPS 1/2** pipe nipple, and bronze ball valve.

C. Include metal enclosure labeled "MANUAL CONTROL STATION," with operating instructions and cover held closed by breakable strut to prevent accidental opening.

2.8 CONTROL PANELS

A. Description: Single-area, two-area, or single-area cross-zoned control panel as indicated, including NEMA ICS 6, Type 1 enclosure, detector, alarm, and solenoid-valve circuitry for operation of deluge valves.

1. Listed in ULSE's "Fire Protection Equipment Directory" or FM Approvals' "Approval Guide" when used with thermal detectors and Class A detector circuit wiring.
2. Electrical characteristics are 120 V ac, 60 Hz, with 24 V dc rechargeable batteries.
3. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Manual Control Stations, Electric Operation: Metal enclosure, labeled "MANUAL CONTROL STATION," with operating instructions and cover held closed by breakable strut to prevent accidental opening.

C. Manual Control Stations, Hydraulic Operation: Provide union, **NPS 1/2** pipe nipple, and bronze ball valve. Include metal enclosure, labeled "MANUAL CONTROL STATION," with operating instructions and cover held closed by breakable strut to prevent accidental opening.

D. Panel Components:

1. Power supply.
2. Battery charger.
3. Standby batteries.
4. Field-wiring terminal strip.
5. Electrically supervised solenoid valves and polarized fire-alarm bell.
6. Lamp test facility.
7. Single-pole, double-throw auxiliary alarm contacts.
8. Rectifier.

PART 3 - EXECUTION

3.1 PREPARATION

A. Perform fire-hydrant flow test. Use results for system design calculations required in "Quality Assurance" Article.

1. Flow test is to be performed to meet the criteria established by NFPA 13.
2. Flow test is to be conducted in accordance with NFPA 291.
3. Test is to be performed during a period of ordinary demand for the water system.

    a. To obtain satisfactory test results of expected flow or rated capacities, sufficient discharge should be achieved to cause drop of at least 10 percent.

4. Pitot readings are to be taken at the **2-1/2-inch** orifice connection.
5. The pitot reading is to range from **10 to 35 psig**.
6. Open additional hydrant outlets as needed to control pitot readings.
7. The pitot pressure and corresponding residual pressure readings are to be taken consecutively as pressure fluctuates between a high number and low number.

B. Flow Test Data Written Report:

1. Flow data report is to be written in accordance with NFPA 291.
2. Flow data report is to include a copy of all flow data recorded during the test, including a site plan showing the tested fire hydrants with respect to the fire water service to the building. Site plan is to indicate which hydrant was flowed and which hydrant was used for pressure reading. Provide date of test, name of testing agency, and name of individual performing test.

C. Water Supply Curve: Provide water supply curve based on the lowest supply for a given set of test data. For a given residual pressure reading, the supply is to be graphed utilizing the corresponding pitot pressure/flow reading and static pressure reading.

D. Documentation is to include calibration certifications for gauges used in the flow tests. The certifications are to be from within the previous six (6) months from a reputable agency recognized for certifying pressure gauges.

E. Report flow test results promptly and in writing. A copy of the flow test data report is to be submitted with the hydraulic calculations.

3.2 INSTALLATION OF FIRE-SUPPRESSION WATER-SERVICE PIPING

A. Comply with requirements for fire-suppression water-service piping in Section 331415 "Site Water Distribution Piping."

3.3 INSTALLATION OF DOMESTIC WATER-SUPPLY CONNECTIONS

A. Connect fire-suppression water piping to building's interior domestic water-distribution piping. Comply with requirements for interior piping in Section 221116 "Domestic Water Piping."

B. Install shutoff valve, backflow preventer, pressure gauge, drain, and other accessories indicated at connection to water-distribution piping. Comply with requirements for backflow preventers in Section 331415 "Site Water Distribution Piping."

3.4 INSTALLATION OF FIRE-SUPPRESSION PIPING

A. Locations and Arrangements: Drawing plans, schematics, and diagrams indicate general location and arrangement of piping. Install piping as indicated on approved working plans.

1. Deviations from approved working plans for piping require written approval from AHJs. File written approval with Architect before deviating from approved working plans.
2. Coordinate layout and installation of sprinklers with other construction that penetrates ceilings, including light fixtures, HVAC equipment, and partition assemblies.

B. Piping Standard: Comply with NFPA 13 requirements for installation of fire-suppression piping.

C. Install seismic restraints on piping. Comply with NFPA standards requirements for seismic-restraint device materials and installation.

D. Install listed fittings to make changes in direction, branch takeoffs from mains, and reductions in pipe sizes.

E. Install unions adjacent to each valve in pipes **NPS 2** and smaller.

F. Install flanges, flange adapters, or couplings for grooved-end piping on valves, apparatus, and equipment having **NPS 2-1/2** and larger end connections.

G. Install inspector's test connections in sprinkler system piping, complete with shutoff valve, and sized and located in accordance with NFPA 13.

H. Install fire-suppression system piping with drains for complete system drainage. Extend drain piping to exterior of building where possible.

I. Install sprinkler control valves, test assemblies, and drain risers adjacent to standpipes when sprinkler piping is connected to standpipes.

J. Install automatic (ball drip) drain valve at each check valve for fire department connection, to drain piping between fire department connection and check valve. Install drain piping to and spill over floor drain or to exterior of building.

K. Install alarm devices in piping systems.

L. Install hangers and supports for fire-suppression piping in accordance with NFPA standards. Comply with requirements for hanger materials in NFPA standards. In seismic-rated areas, refer to Section 210548 "Vibration and Seismic Controls for Fire-Suppression Piping and Equipment."

M. Install pressure gauges on riser or feed main, at each sprinkler test connection, and at top of each standpipe/sprinkler supply. Include pressure gauges with connection not less than **NPS 1/4** and with soft-metal seated globe valve, arranged for draining pipe between gauge and valve. Install gauges to permit removal, and install where they are not subject to freezing.

N. Pressurize and check dry-pipe standpipe or sprinkler system piping and air-pressure maintenance devices.

O. Fill wet-type fire-suppression system piping with water.

P. Drain dry-type fire-suppression system piping.

1. Install electric heating cables and pipe insulation on fire-suppression piping in areas subject to freezing. Comply with requirements for heating cables in Section 210533 "Heat Tracing for Fire-Suppression Piping" and for piping insulation in Section 210700 "Fire-Suppression Systems Insulation."

Q. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 210500 "Common Work Results for Fire-Suppression Piping."

R. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 210500 "Common Work Results for Fire-Suppression Piping."

S. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 210500 "Common Work Results for Fire-Suppression Piping."

3.5 INSTALLATION OF PIPING JOINTS

A. Install couplings, flanges, flanged fittings, unions, nipples, and transition and special fittings that have finish and pressure ratings same as or higher than system's pressure rating for aboveground applications unless otherwise indicated.

B. Install unions adjacent to each valve in pipes **NPS 2** and smaller.

C. Install flanges, flange adapters, or couplings for grooved-end piping on valves, apparatus, and equipment having **NPS 2-1/2** and larger end connections.

D. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

E. Remove scale, slag, dirt, and debris from inside and outside of pipes, tubes, and fittings before assembly.

F. Flanged Joints: Select appropriate gasket material in size, type, and thickness suitable for water service. Join flanges with gasket and bolts in accordance with ASME B31.9.

G. Threaded Joints: Thread pipe with tapered pipe threads in accordance with ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:

1. Apply appropriate tape or thread compound to external pipe threads.
2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.

H. Twist-Locked Joints: Insert plain end of steel pipe into plain-end-pipe fitting. Rotate retainer lugs one-quarter turn or tighten retainer pin.

I. Steel-Piping, Pressure-Sealed Joints: Join steel pipe and steel pressure-seal fittings with tools recommended by fitting manufacturer.

J. Welded Joints: Construct joints in accordance with AWS D10.12M/D10.12, using qualified processes and welding operators in accordance with "Quality Assurance" Article.

1. Shop weld pipe joints where welded piping is indicated. Do not use welded joints for galvanized-steel pipe.

K. Steel-Piping, Cut-Grooved Joints: Cut square-edge groove in end of pipe in accordance with AWWA C606. Assemble coupling with housing, gasket, lubricant, and bolts. Join steel pipe and grooved-end fittings in accordance with AWWA C606 for steel-pipe joints.

L. Steel-Piping, Roll-Grooved Joints: Roll rounded-edge groove in end of pipe in accordance with AWWA C606. Assemble coupling with housing, gasket, lubricant, and bolts. Join steel pipe and grooved-end fittings in accordance with AWWA C606 for steel-pipe grooved joints.

M. Brazed Joints: Join copper tube and fittings in accordance with Copper Development Association's "Copper Tube Handbook," "Brazed Joints" chapter.

N. Copper-Tubing Grooved Joints: Roll rounded-edge groove in end of tube in accordance with AWWA C606. Assemble coupling with housing, gasket, lubricant, and bolts. Join copper tube and grooved-end fittings in accordance with AWWA C606 for steel-pipe grooved joints.

O. Copper-Tubing, Pressure-Sealed Joints: Join copper tube and copper pressure-seal fittings with tools recommended by fitting manufacturer.

P. Extruded-Tee Connections: Form tee in copper tube in accordance with ASTM F2014. Use tool designed for copper tube; drill pilot hole, form collar for outlet, dimple tube to form seating stop, and braze branch tube into collar.

Q. Dissimilar-Material Piping Joints: Make joints using adapters compatible with materials of both piping systems.

R. Plastic-Piping, Solvent-Cement Joints: Clean and dry joining surfaces. Join pipe and fittings in accordance with the following:

1. Comply with ASTM F402 for safe-handling practice of cleaners, primers, and solvent cements. Apply primer.
2. CPVC Piping: Join in accordance with ASTM D2846/D2846M Appendix.

3.6 INSTALLATION OF FIRE DEPARTMENT CONNECTIONS

A. Install wall-type fire department connections.

B. Install yard-type fire department connections in concrete slab support. Comply with requirements for concrete in Section 033000 "Cast-in-Place Concrete."

C. Install two protective pipe bollards around each fire department connection. Comply with requirements for bollards in Section 055000 "Metal Fabrications."

D. Install automatic (ball-drip) drain valve at each check valve for fire department connection.

3.7 INSTALLATION OF HOSE CONNECTIONS AND HOSE STATIONS

A. Examine roughing-in for hose connections and hose stations to verify actual locations of piping connections before installation.

B. Examine walls and partitions for suitable thickness, fire- and smoke-rated construction, framing for hose-station cabinets, and other conditions where hose connections and hose stations are to be installed.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

D. Install hose connections adjacent to standpipes.

E. Install freestanding hose connections and hose stations for access and minimum passage restriction.

F. Install **NPS 1-1/2** hose-connection and hose-station valves with flow-restricting device unless otherwise indicated.

G. Install **NPS 2-1/2** hose connections with quick-disconnect **NPS 2-1/2 by NPS 1-1/2** reducer adapter and flow-restricting device unless otherwise indicated.

H. Install wall-mounted-type hose connections and wall-mounted, rack hose stations in cabinets. Include pipe escutcheons, with finish matching valves, inside cabinet where water-supply piping penetrates cabinet. Install valves at angle required for connection of fire hose. Comply with requirements for cabinets in Section 104413 "Fire Protection Cabinets."

I. Install freestanding hose stations with support or bracket attached to standpipe.

J. Install hose-reel hose stations on wall with bracket.

3.8 INSTALLATION OF COVER SYSTEM FOR SPRINKLER PIPING

A. Install cover system, brackets, and cover components for sprinkler piping in accordance with manufacturer's installation manual and in accordance with NFPA 13 or NFPA 13R for supports.

3.9 INSTALLATION OF VALVES AND SPECIALTIES

A. Install listed fire-suppression system control valves, trim and drain valves, specialty valves and trim, controls, and specialties in accordance with manufacturer's installation instructions, NFPA standards, and AHJ.

B. Install listed fire-suppression system shutoff valves in supervised open position, located to control sources of water supply except from fire department connections. Install permanent identification signs indicating portion of system controlled by each valve.

C. System Control Valves:

1. Install alarm valves with bypass check valve and retarding chamber drain-line connection.
2. Install dry-pipe valves with trim sets for air supply, drain, priming level, alarm connections, ball-drip valves, pressure gauges, priming chamber attachment, and fill-line attachment.

    a. Install air compressor and compressed-air-supply piping.
    b. Install air-pressure maintenance device with shutoff valves to permit servicing without shutting down system; bypass valve for quick system filling; pressure regulator or switch to maintain system pressure; strainer; pressure ratings with 14 to 60 psig adjustable range; and 175 psig maximum inlet pressure.
    c. Install compressed-air-supply piping from building's compressed-air piping system.

3. Install deluge valves with trim sets for drain, priming level, alarm connections, ball-drip valves, pressure gauges, priming chamber attachment, and fill-line attachment.

D. Air Vent:

1. Provide at least one air vent at high point in each wet-pipe fire-suppression system in accordance with NFPA standards. Connect vent into top of fire-suppression piping.
2. Provide dielectric union for dissimilar metals, ball valve, and strainer upstream of automatic air vent.
3. Pipe from outlet of air vent to drain.

3.10 INSTALLATION OF NITROGEN GENERATOR WITH PURGE/VENT SYSTEM

A. Install in accordance with manufacturer's written installation instructions.

B. Locate purge vent/valve in accordance with manufacturer's written installation instructions.

C. Route alarm signals in code-approved electrical conduit from nitrogen generator system control panel to the supervisory circuit of BAS.

3.11 IDENTIFICATION

A. Install labeling and pipe markers on equipment and piping in accordance with requirements for identification specified in Section 210553 "Identification for Fire-Suppression Piping and Equipment."

B. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

3.12 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Perform the following tests and inspections with the assistance of a factory-authorized service representative:

1. Leak Test: After installation, charge systems and test for leaks. Repair leaks and retest until no leaks exist.
2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
3. Flush, test, and inspect fire-suppression systems in accordance with NFPA standards.
4. Energize circuits to electrical equipment and devices.
5. Start and run air compressors.
6. Coordinate with fire-alarm tests. Operate as required.
7. Coordinate with fire-pump tests. Operate as required.
8. Verify that equipment hose threads are same as local fire department equipment.
9. Verify that sprinklers' original factory finish has not been contaminated with dirt, debris, or paint. Sprinklers containing other-than-original factory finish are to be considered defective and replaced with new products. Repair and/or cleaning is not acceptable.

C. Fire-suppression piping system will be considered defective if it does not pass tests and inspections.

D. Fire-suppression piping system components considered defective during testing will be replaced with new components. Repair of defective components is not acceptable.

E. Prepare test and inspection reports.

3.13 CLEANING

A. Clean dirt and debris from fire-suppression system piping, system control valves, sprinklers, and associated components.

B. Only sprinklers with their original factory finish are acceptable. Remove and replace any sprinklers that are painted or have any other finish than their original factory finish.

3.14 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain system control valves and pressure-maintenance pumps.

3.15 PIPING SCHEDULE

A. Piping between Fire Department Connections and Check Valves: Galvanized, standard-weight steel pipe with grooved ends, grooved-end fittings, grooved-end-pipe couplings, and grooved joints.

B. Sprinkler specialty fittings may be used, downstream of control valves, instead of specified fittings.

C. Copper-tube, extruded-tee connections may be used for tee branches in copper tubing instead of specified copper fittings. Branch-connection joints must be brazed.

D. CPVC pipe, Schedule 80 CPVC fittings, and solvent-cemented joints may be used for light-hazard and residential occupancies.

E. Standard-Pressure, Wet-Pipe Sprinkler System, NPS 2 (DN 50) and Smaller, to Be One of the Following:

1. Schedule 40, black-steel pipe with threaded ends; uncoated, gray-iron threaded fittings; and threaded joints.
2. Schedule 40, galvanized-steel pipe with threaded ends; galvanized, gray-iron threaded fittings; and threaded joints.
3. Schedule 40, black-steel pipe with plain ends; uncoated, plain-end-pipe fittings; and twist-locked joints.
4. Schedule 40, galvanized-steel pipe with plain ends; galvanized, plain-end-pipe fittings; and twist-locked joints.
5. Schedule 40, black-steel pipe with cut- grooved ends; uncoated, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.
6. Schedule 40, galvanized-steel pipe with cut-grooved ends; galvanized, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.
7. Schedule 40, black-steel pipe with plain ends; steel welding fittings; and welded joints.
8. Schedule 10, steel pipe with roll-grooved ends; uncoated, grooved-end fittings for

steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.

9. Schedule 10, steel pipe with plain ends; uncoated, plain-end-pipe fittings; and twist-locked joints.
10. Schedule 10, steel pipe with plain ends; welding fittings; and welded joints.
11. Schedule 40 steel pipe; steel pressure-seal fittings; and pressure-sealed joints.
12. Type L, hard copper tube with plain ends; cast- copper, solder-joint fittings; and brazed joints.
13. Type L, hard copper tube with plain ends; copper pressure-seal fittings; and pressure-sealed joints.
14. **NPS 2**, Type L, hard copper tube with roll-grooved ends; copper, grooved-end fittings; grooved-end-tube couplings; and grooved joints.

F. Standard-Pressure, Wet-Pipe Sprinkler System, NPS 2-1/2 to NPS 4 (DN 65 to DN 100), to Be One of the Following:

1. Schedule 40, black-steel pipe with threaded ends; uncoated, gray-iron threaded fittings; and threaded joints.
2. Schedule 40, galvanized-steel pipe with threaded ends; galvanized, gray-iron threaded fittings; and threaded joints.
3. Schedule 40, black-steel pipe with cut- grooved ends; uncoated, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.
4. Schedule 40, galvanized-steel pipe with cut-grooved ends; galvanized, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.
5. Schedule 40, black-steel pipe with plain ends; steel welding fittings; and welded joints.
6. Schedule 10, steel pipe with roll-grooved ends; uncoated, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.
7. Schedule 10, steel pipe with plain ends; welding fittings; and welded joints.
8. Type L, hard copper tube with plain ends; cast- copper, solder-joint fittings; and brazed joints.
9. Type L, hard copper tube with plain ends; copper pressure-seal fittings; and pressure-sealed joints.
10. Type L, hard copper tube with roll-grooved ends; copper, grooved-end fittings; grooved-end-tube couplings; and grooved joints.

G. Standard-Pressure, Wet-Pipe Sprinkler System, NPS 5 (DN 125) and Larger, to Be One of the Following:

1. Schedule 40, black-steel pipe with threaded ends; uncoated, gray-iron threaded fittings; and threaded joints.
2. Schedule 40, galvanized-steel pipe with threaded ends; galvanized, gray-iron threaded fittings; and threaded joints.
3. Schedule 40, black-steel pipe with cut- grooved ends; uncoated, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.
4. Schedule 40, galvanized-steel pipe with cut-grooved ends; galvanized, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.
5. Schedule 40, black-steel pipe with plain ends; steel welding fittings; and welded

joints.

6. Schedule 10, steel pipe with roll-grooved ends; uncoated, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.
7. Schedule 10, steel pipe with plain ends; welding fittings; and welded joints.
8. Type L, hard copper tube with plain ends; cast- copper, solder-joint fittings; and brazed joints.
9. Type L, hard copper tube with roll-grooved ends; copper, grooved-end fittings; grooved-end-tube couplings; and grooved joints.

H. High-Pressure, Wet-Pipe Sprinkler System, NPS 4 (DN 100) and Smaller, to Be One of the Following:

1. Schedule 40, galvanized-steel pipe with threaded ends; galvanized, gray-iron threaded fittings; and threaded joints.
2. Schedule 40, galvanized-steel pipe with cut-grooved ends; galvanized, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.
3. Schedule 40, black-steel pipe with plain ends; steel welding fittings; and welded joints.
4. Schedule 10, steel pipe with plain ends; welding fittings; and welded joints.

I. High-Pressure, Wet-Pipe Sprinkler System, NPS 5 (DN 125) and Larger, to Be One of the Following:

1. Schedule 40, galvanized-steel pipe with threaded ends; galvanized, gray-iron threaded fittings; and threaded joints.
2. Schedule 40, galvanized-steel pipe with cut-grooved ends; galvanized, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.
3. Schedule 40, black-steel pipe with plain ends; steel welding fittings; and welded joints.
4. Schedule 10, steel pipe with plain ends; welding fittings; and welded joints.

3.16 SPRINKLER SCHEDULE

A. Use sprinkler types in subparagraphs below for the following applications:

1. Rooms without Ceilings: Upright sprinklers.
2. Rooms with Suspended Ceilings: Recessed sprinklers.
3. Wall Mounting: Horizontal sidewall sprinklers.
4. Spaces Subject to Freezing: Dry sidewall sprinklers.
5. Deluge-Sprinkler Systems: Upright and pendent, open sprinklers.
6. Special Applications: Attic sprinklers Combustible concealed space sprinklers.

B. Provide sprinkler types in subparagraphs below with finishes indicated.

1. Upright, Pendent, and Sidewall Sprinklers: Chrome plated in finished spaces exposed to view; rough bronze in unfinished spaces and locations not generally exposed to view; and wax coated where exposed to acids, chemicals, or other corrosive fumes.

2. Recessed Sprinklers: Bright chrome, with bright chrome escutcheon.
3. Flat Concealed Sprinklers: Rough brass, with factory-painted white cover plate.
4. Residential Sprinklers: Dull chrome.

END OF SECTION 21 10 00

SECTION 22 05 00 - COMMON WORK RESULTS FOR PLUMBING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Motors.
2. Packless expansion joints.
3. Alignment guides and anchors.
4. Sleeves without waterstop.
5. Sleeves with waterstop.
6. Grout.
7. Silicone sealants.
8. Escutcheons.
9. Thermometers, bimetallic actuated, lead free.
10. Thermometers, filled system, lead free.
11. Thermometers, liquid in glass, lead free.
12. Thermometers, light activated, lead free.
13. Thermowells, lead free.
14. Pressure gauges, dial type, lead free.
15. Gauge attachments, lead free.
16. Test plugs, lead free.

B. Related Requirements:

1. Section 221119 "Domestic Water Piping Specialties" for water meters.
2. Section 221513 "General-Service Compressed-Air Piping" for compressed air gauges.
3. Section 331415 "Site Water Distribution Piping" for domestic water meters and combined domestic and fire-protection water-service meters outside the building.

1.2 DEFINITIONS

A. Existing Piping to Remain: Existing piping that is not to be removed and that is not otherwise indicated to be removed, removed and salvaged, or removed and reinstalled.

1.3 ACTION SUBMITTALS

A. Product Data:

1. For each type of product, excluding motors which are included in Part 1 of the plumbing equipment Sections.

a. Include construction details, material descriptions, and dimensions of individual components, and finishes.

b. Include operating characteristics and furnished accessories.

B. Delegated Design Submittals: For each anchor and alignment guide, including analysis data, signed and sealed by the qualified professional engineer responsible for their preparation.

1. Design Calculations: Calculate requirements for thermal expansion of piping systems and for selecting and designing expansion joints, loops, and swing connections.
2. Anchor Details: Detail fabrication of each anchor indicated. Show dimensions and methods of assembly and attachment to building structure.
3. Alignment Guide Details: Detail field assembly and attachment to building structure.
4. Schedule: Indicate type, manufacturer's number, size, material, pressure rating, end connections, and location for each expansion joint.

C. Sustainable Design Submittals:

1.4 INFORMATIONAL SUBMITTALS

A. Welding certificates.

B. Field quality-control reports.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For each type of expansion joint, andgauge to include in operation and maintenance manuals.

1.6 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel in accordance with AWS D1.1/D1.1M.

B. Pipe and Pressure-Vessel Welding Qualifications: Qualify procedures and operators in accordance with 2021 ASME Boiler and Pressure Vessel Code, Section IX.

1.7 COORDINATION

A. Coordinate features of motors, installed units, and accessory devices to be compatible with the following:

1. Motor controllers.
2. Torque, speed, and horsepower requirements of the load.
3. Ratings and characteristics of supply circuit and required control sequence.
4. Ambient and environmental conditions of installation location.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Domestic water expansion fittings and loops for plumbing piping intended to convey or dispense water for human consumption are to comply with the U.S. Safe Drinking Water Act, with requirements of authorities having jurisdiction, and with NSF 61 and NSF 372, or be certified in compliance with NSF 61 and NSF 372 by an ANSI-accredited third-party certification body, in that the weighted average lead content at wetted surfaces is less than or equal to 0.25 percent.

B. Compatibility: Provide products suitable for piping service fluids, materials, working pressures, and temperatures.

C. Capability: Provide products and installations to accommodate maximum axial movement as scheduled or indicated on Drawings.

2.2 MOTORS

A. Motor Requirements, General:

1. Content includes motors for use on alternating-current power systems of up to 600 V and installed at equipment manufacturer's factory or shipped separately by equipment manufacturer for field installation.
2. Comply with requirements in this Section except when stricter requirements are specified in equipment schedules or Sections.
3. Comply with NEMA MG 1 unless otherwise indicated.
4. Comply with IEEE 841 for severe-duty motors.

B. Motor Characteristics:

1. Duty: Continuous duty at ambient temperature of 40 deg C and at altitude of **3300 ft.** above sea level.
2. Capacity and Torque Characteristics: Sufficient to start, accelerate, and operate connected loads at designated speeds, at installed altitude and environment, with indicated operating sequence, and without exceeding nameplate ratings or considering service factor.

C. Polyphase Motors:

1. Description: NEMA MG 1, Design B, medium induction motor.
2. Efficiency: Premium Efficient, as defined in NEMA MG 1.
3. Service Factor: 1.15.
4. Multispeed Motors: Variable torque.

    a. For motors with 2:1 speed ratio, consequent pole, single winding.
    b. For motors with other than 2:1 speed ratio, separate winding for each speed.

5. Multispeed Motors, Two Winding: Separate winding for each speed.
6. Rotor: Random-wound, squirrel cage.
7. Bearings: Regreasable, shielded, antifriction ball bearings suitable for radial and thrust loading.
8. Temperature Rise: Match insulation rating.
9. Insulation: Class F.
10. Code Letter Designation:

    a. Motors 15 HP and Larger: NEMA starting Code F or Code G.
    b. Motors Smaller Than 15 HP: Manufacturer's standard starting characteristic.

11. Enclosure Material: Cast iron for motor frame sizes 324T and larger; rolled steel for motor frame sizes smaller than 324T.

D. Additional Requirements for Polyphase Motors:

1. Motors Used with Reduced-Voltage and Multispeed Controllers: Match wiring connection requirements for controller with required motor leads. Provide terminals in motor terminal box, suited to control method.
2. Motors Used with Variable-Frequency Controllers: Ratings, characteristics, and features coordinated with and approved by controller manufacturer.

    a. Windings: Copper magnet wire with moisture-resistant insulation varnish, designed and tested to resist transient spikes, high frequencies, and short time-rise pulses produced by pulse-width-modulated inverters.
    b. Premium-Efficient Motors: Class B temperature rise; Class F insulation.
    c. Inverter-Duty Motors: Class F temperature rise; Class H insulation.
    d. Thermal Protection: Comply with NEMA MG 1 requirements for thermally protected motors.

3. Severe-Duty Motors: Comply with IEEE 841, with 1.15 minimum service factor.

E. Single-Phase Motors:

1. Motors larger than 1/20 hp must be one of the following, to suit starting torque and requirements of specific motor application:

    a. Permanent-split capacitor.
    b. Split phase.
    c. Capacitor start, inductor run.
    d. Capacitor start, capacitor run.

2. Multispeed Motors: Variable-torque, permanent-split-capacitor type.
3. Bearings: Prelubricated, antifriction ball bearings or sleeve bearings suitable for radial and thrust loading.
4. Motors 1/20 HP and Smaller: Shaded-pole type.
5. Thermal Protection: Internal protection to automatically open power supply circuit to motor when winding temperature exceeds a safe value calibrated to temperature rating of motor insulation. Thermal-protection device will automatically reset when motor temperature returns to normal range.

F. Electronically Commutated Motors:

1. Microprocessor-Based Electronic Control Module: Converts 120 V or 240 V single-phase AC power to three-phase DC power to operate the brushless DC motor.
2. Three-phase power motor module with permanent magnet rotor.
3. Circuit board or digital speed controller/LED display.
4. Building Automation System Interface: Via AC voltage signal.

2.3 EXPANSION FITTINGS AND LOOPS FOR PLUMBING PIPING

A. Packless Expansion Joints:

1. Rubber Union Connector Expansion Joints, Lead Free: RUEJLF-01.

a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1) Amber/Booth Company, Inc.; a VMC Group Company
2) Flex-Hose Co., Inc
3) Flexicraft Industries
4) Flo Fab Inc
5) General Rubber Corporation
6) Kadant Unaflex, LLC
7) Mason Industries, Inc.
8) Metraflex Company (The)
9) Proco Products, Inc
10) Unisource Manufacturing, Inc.

b. Source Limitations: Obtain rubber union connector expansion joints from single manufacturer.
c. Material: Twin reinforced EPDM rubber spheres with external restraining cables.
d. Minimum Pressure Rating: 150 psig at 170 deg F unless otherwise indicated.
e. End Connections for NPS 2 (DN 50) and Smaller: Threaded.
f. End Connections for Greater than NPS 2 (DN 50): Flanged.
g. End Fittings: Stainless steel.

2. Flexible-Hose Packless Expansion Joints, Lead Free: FHEJLF-01.

a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1) ASC Engineered Solutions
2) Flex-Hose Co., Inc
3) Flex-Pression
4) Flex-Weld; a division of Kelco

5) Flexicraft Industries
6) Kadant Unaflex, LLC
7) Mason Industries, Inc.
8) Proco Products, Inc
9) Unisource Manufacturing, Inc.

b. Source Limitations: Obtain flexible-hose packless expansion joints from single manufacturer.
c. Description: Manufactured assembly with inlet and outlet elbow fittings and two flexible-metal-hose legs joined by long-radius, 180-degree return bend or center section of flexible hose.
d. Flexible Hose: Corrugated-metal inner hoses and braided outer sheaths.
e. Expansion Joints for Copper Tubing NPS 2 (DN 50) and Smaller: Copper-alloy fittings with solder-joint end connections.

1) Bronze hoses and single-braid bronze sheaths with **450 psig at 70 deg F** and **340 psig at 450 deg F** ratings.
2) Bronze hoses and double-braid bronze sheaths with **700 psig at 70 deg F** and **500 psig at 450 deg F** ratings.

f. Expansion Joints for Copper Tubing NPS 2-1/2 to NPS 4 (DN 65 to DN 100): Copper-alloy fittings with threaded end connections.

1) Stainless steel hoses and single-braid, stainless steel sheaths with **300 psig at 70 deg F** and **225 psig at 450 deg F** ratings.
2) Stainless steel hoses and double-braid, stainless steel sheaths with **420 psig at 70 deg F** and **315 psig at 450 deg F** ratings.

g. Expansion Joints for Stainless Steel Piping NPS 2 (DN 50) and Smaller: Stainless steel fittings with threaded end connections.

1) Stainless steel hoses and single-braid, stainless steel sheaths with **450 psig at 70 deg F** and **325 psig at 600 deg F** ratings.
2) Stainless steel hoses and double-braid, stainless steel sheaths with **700 psig at 70 deg F** and **515 psig at 600 deg F** ratings.

h. Expansion Joints for Stainless Steel Piping NPS 2-1/2 to NPS 6 (DN 65 to DN 150): Stainless steel fittings with flanged end connections.

1) Stainless steel hoses and single-braid, stainless steel sheaths with **200 psig at 70 deg F** and **145 psig at 600 deg F** ratings.
2) Stainless steel hoses and double-braid, stainless steel sheaths with **275 psig at 70 deg F** and **200 psig at 600 deg F** ratings.

i. Expansion Joints for Stainless Steel Piping NPS 8 to NPS 12 (DN 200 to DN 300): Stainless steel fittings with flanged end connections.

1) Stainless steel hoses and single-braid, stainless steel sheaths with **125 psig at 70 deg F** and **90 psig at 600 deg F** ratings.
2) Stainless steel hoses and double-braid, stainless steel sheaths with **165 psig at 70 deg F** and **120 psig at 600 deg F** ratings.

j. Expansion Joints for Stainless Steel Piping NPS 14 (DN 350) and Larger: Stainless steel fittings with flanged end connections.

1) Stainless steel hoses and double-braid, stainless steel sheaths with **165 psig at 70 deg F** and **120 psig at 600 deg F** ratings.

3. Rubber Packless Expansion Joints, Lead Free: REJLF-01.

a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1) Amber/Booth Company, Inc.; a VMC Group Company
2) Flex-Hose Co., Inc
3) Flex-Weld; a division of Kelco
4) Flexicraft Industries
5) Garlock Sealing Technologies
6) General Rubber Corporation
7) Kadant Unaflex, LLC
8) Mason Industries, Inc.
9) Proco Products, Inc
10) Red Valve Company, Inc
11) Tozen Corporation
12) U.S. Bellows, Inc.
13) Unisource Manufacturing, Inc.

b. Source Limitations: Obtain rubber packless expansion joints from single manufacturer.
c. Standards: ASTM F1123 and FSA's "Expansion Joints - Piping Technical Handbook."
d. Material: Fabric-reinforced rubber complying with FSA-PSJ-703.
e. Arch Type: Single or multiple arches with external control rods.
f. Spherical Type: Single or multiple spheres with external control rods.
g. Minimum Pressure Rating for NPS 1-1/2 to NPS 12 (DN 40 to DN 300): 225 psig at 170 deg F.

B. Alignment Guides and Anchors:

1. Alignment Guides: AG-01.

a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1) Advanced Thermal Systems, Inc
2) ASC Engineered Solutions
3) Flex-Hose Co., Inc
4) Flex-Weld; a division of Kelco
5) Flexicraft Industries
6) Hyspan Precision Products, Inc
7) Metraflex Company (The)

b. Source Limitations: Obtain alignment guides from single manufacturer.
c. Description: Steel, factory-fabricated alignment guide, with bolted two-section outer cylinder and base for attaching to structure; with two-section guiding slider for bolting to pipe. Provide dielectric spacer for use with copper tubing/piping.

2. Anchor Materials:

a. Steel Shapes and Plates: ASTM A36/A36M.
b. Bolts and Nuts: ASME B18.10 or ASTM A183, steel hex head.
c. Washers: ASTM F844, steel, plain, flat washers.
d. Mechanical Fasteners: Insert-wedge-type stud with expansion plug anchor for use in hardened portland cement concrete, with tension and shear capacities appropriate for application.

1) Stud: Threaded, zinc-coated carbon steel.
2) Expansion Plug: Zinc-coated carbon steel.
3) Washer and Nut: Zinc-coated carbon steel.

e. Chemical Fasteners: Insert-type stud, bonding-system anchor for use with hardened portland cement concrete, with tension and shear capacities appropriate for application.

1) Bonding Material: ASTM C881/C881M, Type IV, Grade 3, two-component epoxy resin suitable for surface temperature of hardened concrete where fastener is to be installed.
2) Stud: ASTM A307, zinc-coated carbon steel with continuous thread on stud unless otherwise indicated.
3) Washer and Nut: Zinc-coated carbon steel.

2.4 SLEEVES AND SLEEVE SEALS

A. Sleeves without Waterstop:

1. Cast-Iron Pipe Sleeves: Cast or fabricated of cast or ductile iron, with plain ends.
2. Steel Pipe Sleeves: ASTM A53/A53M, Type E, Grade B, Schedule 40, hot-dip galvanized, with plain ends.
3. Steel Sheet Sleeves: ASTM A653/A653M, **24 gauge** minimum thickness; hot-dip galvanized, round tube closed with welded longitudinal joint.
4. PVC Pipe Sleeves: ASTM D1785, Schedule 40.
5. Molded-PVC Sleeves: With nailing flange.
6. Molded-PE or -PP Sleeves: Removable, tapered-cup shaped, and smooth outer surface with nailing flange.

B. Sleeves with Waterstop:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Advance Products & Systems, LLC
b. American Polywater Corporation
c. CALPICO, Inc.
d. GPT Industries, LLC.
e. Metraflex Company (The)

2. Description: Manufactured stainless steel, sleeve-type, waterstop assembly made for imbedding in concrete slab or wall.

C. Sleeve-Seal Systems:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Advance Products & Systems, LLC
b. American Polywater Corporation
c. GPT Industries, LLC.
d. Metraflex Company (The)
e. Proco Products, Inc

2. Basis-of-Design Product: Subject to compliance with requirements, provide sleeves or comparable product by one of the following:

a. Advance Products & Systems, LLC
b. American Polywater Corporation
c. GPT Industries, LLC.
d. Metraflex Company (The)
e. Proco Products, Inc

3. Description: Modular sealing-element unit, designed for field assembly, for filling annular space between piping and sleeve.

a. Hydrostatic Seal: **20 psig** minimum.
b. Sealing Elements: EPDM-rubber interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
c. Pressure Plates: Carbon steel.
d. Connecting Bolts and Nuts: Carbon steel, with zinc coating, ASTM B633 of length required to secure pressure plates to sealing elements.

D. Grout:

1. Description: Nonshrink, for interior and exterior sealing openings in non-fire-rated walls or floors.
2. Standard: ASTM C1107/C1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.
3. Design Mix: **5000 psi**, 28-day compressive strength.
4. Packaging: Premixed and factory packaged.

E. Silicone Sealants:

1. Silicone Sealant, S, NS, 25, NT: Single-component, nonsag, plus 25 percent and minus 25 percent movement capability, nontraffic-use, neutral-curing silicone joint sealant.

    a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

        1) GE Construction Sealants; Momentive Performance Materials Inc.
        2) ITW Polymers Sealants North America
        3) Polymeric Systems, Inc.; PPG Industries, Inc.
        4) Sherwin-Williams Company (The)
        5) Sika Corporation
        6) The Dow Chemical Company
        7) Tremco Incorporated

    b. Standard: ASTM C920, Type S, Grade NS, Class 25, Use NT.

2. Silicone Foam Sealant: Multicomponent, silicone-based liquid elastomers that, when mixed, expand and cure in place to produce a flexible, nonshrinking foam.

    a. Manufacturers: Subject to compliance with requirements, provide products by the following:

        1) Smooth-On

3. Sealant shall have a VOC content of 250 g/L or less.

    a. Sealant shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
    b. Sealant shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
    c. Sealant shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers." Formaldehyde emissions shall not exceed 9 mcg/cu. m or 7 ppb, whichever is less.
    d. Sealant shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
    e. Sealant shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers." The building concentration of formaldehyde shall not exceed half of the indoor recommended exposure limit, or 33 mcg/cu. m, and that of acetaldehyde shall not exceed 9 mcg/cu.

m.

2.5 ESCUTCHEONS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. BrassCraft Manufacturing Co.; a Masco company
2. Dearborn Brass
3. Jones Stephens Corp.
4. Keeney Manufacturing Company (The)
5. Mid-America Fittings, LLC; A Midland Industries Company
6. ProFlo; a Ferguson Enterprises, Inc. brand

B. Escutcheon Types:

1. One-Piece, Steel Type: With polished brass finish and setscrew fastener.
2. One-Piece, Stainless Steel Type: With polished stainless steel finish.
3. One-Piece, Cast-Brass Type: With polished brass finish and setscrew fastener.
4. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped brass with polished, chrome-plated finish and spring-clip fasteners.
5. One-Piece, Stamped-Steel Type: With polished, chrome-plated finish and spring-clip fasteners.
6. Split-Plate, Stamped-Steel Type: With polished, chrome-plated finish; concealed and exposed-rivet hinge; and spring-clip fasteners.

C. Floor Plates:

1. Split Floor Plates: Cast brass with concealed hinge.

2.6 METERS AND GAUGES FOR PLUMBING PIPING

A. Thermometers, Bimetallic Actuated, Lead Free:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Ashcroft Inc
b. Blue Ribbon Corp.
c. Ernst Flow Industries
d. Marsh Bellofram
e. Miljoco Corporation
f. Noshok
g. Palmer Wahl Instrumentation Group
h. REOTEMP Instrument Corporation
i. Tel-Tru Manufacturing Company
j. Trerice, H. O. Co

k. WATTS; A Watts Water Technologies Company
l. Weiss Instruments, Inc
m. Weksler Glass Thermometer Corp.
n. WIKA Instrument Corporation
o. Winters Instruments - U.S.

2. Source Limitations: Provide lead-free bimetallic-actuated thermometers from a single manufacturer.
3. Standard: ASME B40.200.
4. Case: Liquid-filled and sealed type(s); stainless steel with 3-inch nominal diameter.
5. Dial: Nonreflective aluminum with permanent scale markings and scales in deg F.
6. Connector Type(s): Union joint, adjustable angle; with ASME B1.1 or ASME B1.20.1 screw threads to fit thermowell.
7. Stem: **0.25 or 0.375 inch** in diameter; stainless steel.
8. Window: Plain glass Safety glass or acrylic plastic.
9. Ring: Stainless steel.
10. Element: Bimetal coil.
11. Pointer: Dark-colored metal.
12. Accuracy: Plus or minus 1 percent of span.

B. Thermometers, Filled System, Lead Free - Direct Mounted, Metal Case, Vapor Actuated:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Ashcroft Inc
b. Miljoco Corporation
c. Palmer Wahl Instrumentation Group
d. REOTEMP Instrument Corporation
e. Trerice, H. O. Co
f. Weiss Instruments, Inc

2. Source Limitations: Provide filled-system, lead-free, direct-mounted, metal-case, vapor-actuated thermometers from a single manufacturer.
3. Standard: ASME B40.200.
4. Case: Sealed type, cast aluminum or drawn steel; 4-1/2-inch nominal diameter.
5. Element: Lead-free Bourdon tube.
6. Movement: Mechanical, dampening type, with link to pressure element and connection to pointer.
7. Dial: Nonreflective aluminum with permanent scale markings graduated in deg F.
8. Pointer: Dark-colored metal.
9. Window: Glass Safety glass or acrylic plastic.
10. Ring: Metal.
11. Connector Type(s): Union joint, adjustable, 180 degrees in vertical plane, 360 degrees in horizontal plane, with locking device; with ASME B1.1 or ASME B1.20.1 screw threads to fit thermowell.
12. Thermal System: Liquid-filled, mercury-free bulb in copper-plated steel,

aluminum, or lead-free brass stem and of length to suit installation.

a. Design for Thermowell Installation: Bare stem.

13. Accuracy: Plus or minus 1 percent of span.

C. Thermometers, Filled System, Lead Free - Direct Mounted, Plastic Case, Vapor Actuated:

1. Manufacturers: Subject to compliance with requirements, provide products by the following:

a. REOTEMP Instrument Corporation

2. Basis-of-Design Product: Subject to compliance with requirements, provide thermometer or comparable product by one of the following:

a. REOTEMP Instrument Corporation

3. Source Limitations: Provide filled-system, lead-free, direct-mounted, plastic-case, vapor-actuated thermometers from single manufacturer.
4. Standard: ASME B40.200.
5. Case: Sealed type, plastic; 4-1/2-inch nominal diameter.
6. Element: Lead-free Bourdon tube.
7. Movement: Mechanical, with link to pressure element and connection to pointer.
8. Dial: Nonreflective aluminum with permanent scale markings graduated in deg F.
9. Pointer: Dark-colored metal.
10. Window: Glass Safety glass or acrylic plastic.
11. Ring: Metal or plastic.
12. Connector Type(s): Union joint, adjustable, 180 degrees in vertical plane, 360 degrees in horizontal plane, with locking device; with ASME B1.1 or ASME B1.20.1 screw threads to fit thermowell.
13. Thermal System: Liquid-filled, mercury-free bulb in copper-plated steel or aluminum, or lead-free brass stem and of length to suit installation.

a. Design for Thermowell Installation: Bare stem.

14. Stem Length: To match thermowell insertion length.
15. Accuracy: Plus or minus 1 percent of span.

D. Thermowells, Lead Free:

1. Standard: ASME B40.200.
2. Description: Pressure-tight, socket-type fitting made for insertion into piping tee fitting.
3. Material for Use with Copper Tubing: Lead-free copper.
4. Material for Use with Steel Piping: Type 304 stainless steel.
5. Type: Stepped shank unless straight or tapered shank is indicated.
6. External Threads: **NPS 1/2, NPS 3/4, or NPS 1**, or as required to match threaded opening in pipe.
7. Internal Threads: Size and thread type as required to match thermometer

mounting threads.
8. Bore: Diameter required to match thermometer bulb or stem.
9. Insertion Length: Length to extend a minimum of 2 inches into fluid.
10. Lagging Extension: Include on thermowells for insulated piping and tubing. Extension is to be of sufficient length to extend beyond finished insulation surface.
11. Bushings: For converting size of thermowell's internal screw thread to size of thermometer connection.
12. Heat-Transfer Medium: Mixture of graphite and glycerin.

E. Pressure Gauges, Dial Type, Lead Free - Direct Mounted, Metal Case:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

   a. Ametek U.S. Gauge
   b. Ashcroft Inc
   c. Blue Ribbon Corp.
   d. Ernst Flow Industries
   e. Flo Fab Inc
   f. Marsh Bellofram
   g. Miljoco Corporation
   h. Noshok
   i. Palmer Wahl Instrumentation Group
   j. REOTEMP Instrument Corporation
   k. Tel-Tru Manufacturing Company
   l. Trerice, H. O. Co
   m. WATTS; A Watts Water Technologies Company
   n. Weiss Instruments, Inc
   o. Weksler Glass Thermometer Corp.
   p. WIKA Instrument Corporation
   q. Winters Instruments - U.S.

2. Source Limitations: Provide dial-type, lead-free, direct-mounted, metal-case pressure gauges from single manufacturer.
3. Standard: ASME B40.100.
4. Case: Liquid-filled type(s); cast aluminum or drawn steel; 4-1/2-inch nominal diameter.
5. Pressure-Element Assembly: Lead-free Bourdon tube.
6. Pressure Connection: Lead-free brass, with NPS 1/4, ASME B1.20.1 pipe threads and bottom-outlet type unless back-outlet type is indicated.
7. Movement: Mechanical, with link to pressure element and connection to pointer.
8. Dial: Nonreflective aluminum with permanent scale markings graduated in psi.
9. Pointer: Dark-colored metal.
10. Window: Glass Safety glass or plastic.
11. Ring: Metal.
12. Accuracy: Grade A, plus or minus 1 percent of middle half of span.

F. Pressure Gauges, Dial Type, Lead Free - Direct Mounted, Plastic Case:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

    a. Ametek U.S. Gauge
    b. Ashcroft Inc
    c. Flo Fab Inc
    d. Marsh Bellofram
    e. Miljoco Corporation
    f. Noshok
    g. Palmer Wahl Instrumentation Group
    h. REOTEMP Instrument Corporation
    i. Tel-Tru Manufacturing Company
    j. Trerice, H. O. Co
    k. Weiss Instruments, Inc
    l. Weksler Glass Thermometer Corp.
    m. WIKA Instrument Corporation
    n. Winters Instruments - U.S.

2. Source Limitations: Provide dial-type, lead-free, direct-mounted, plastic-case pressure gauges from a single manufacturer.
3. Standard: ASME B40.100.
4. Case: Sealed type; plastic; 4-1/2-inch nominal diameter.
5. Pressure-Element Assembly: Lead-free Bourdon tube.
6. Pressure Connection: Lead-free brass, with NPS 1/4, ASME B1.20.1 pipe threads and bottom-outlet type unless back-outlet type is indicated.
7. Movement: Mechanical, with link to pressure element and connection to pointer.
8. Dial: Nonreflective aluminum with permanent scale markings graduated in psi.
9. Pointer: Dark-colored metal.
10. Window: Glass Safety glass or acrylic plastic.
11. Accuracy: Grade A, plus or minus 1 percent of middle half of span.

G. Gauge Attachments, Lead Free:

1. Snubbers: ASME B40.100, lead-free brass; with NPS 1/4, ASME B1.20.1 pipe threads and piston -type surge-dampening device. Include extension for use on insulated piping.
2. Valves: Lead-free brass ball, with NPS 1/4, ASME B1.20.1 pipe threads.

H. Test Plugs, Lead Free:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

    a. IMI Flow Design, Inc.
    b. Miljoco Corporation
    c. Nexus Valve, Inc.; Aalberts Hydronic Flow Control
    d. Peterson Equipment Co., Inc
    e. Trerice, H. O. Co
    f. WATTS; A Watts Water Technologies Company

g. Weiss Instruments, Inc
h. Weksler Glass Thermometer Corp.

2. Source Limitations: Provide lead-free test plugs from single manufacturer.
3. Description: Test-station fitting made for insertion into piping tee fitting.
4. Body: Lead-free brass or stainless steel with core inserts and gasketed and threaded cap. Include extended stem on units to be installed in insulated piping.
5. Thread Size: NPS 1/4 or NPS 1/2, ASME B1.20.1 pipe thread.
6. Minimum Pressure and Temperature Rating: 500 psig at 200 deg F.
7. Core Inserts: Chlorosulfonated polyethylene synthetic self-sealing rubber.

PART 3 - EXECUTION

3.1 INSTALLATION OF EXPANSION JOINTS, GENERAL

A. Install expansion joints of sizes matching sizes of piping in which they are installed.

3.2 INSTALLATION OF PACKLESS EXPANSION JOINTS

A. Install metal-bellows expansion joints in accordance with EJMA's "Standards of the Expansion Joint Manufacturers Association, Inc."

B. Install rubber packless expansion joints in accordance with FSA-PSJ-703.

3.3 INSTALLATION OF GROOVED-JOINT EXPANSION JOINTS

A. Install grooved-joint expansion joints to grooved-end steel piping.

3.4 INSTALLATION OF ALIGNMENT GUIDES AND ANCHORS

A. Install alignment guides to guide expansion and to avoid end-loading and torsional stress.

B. Install one guide(s) on each side of pipe expansion fittings and loops. Install guides nearest to expansion joint not more than four pipe diameters from expansion joint.

C. Attach guides to pipe, and secure guides to building structure.

D. Install anchors at locations to prevent stresses from exceeding those permitted by ASME B31.9 and to prevent transfer of loading and stresses to connected equipment.

E. Anchor Attachments:

1. Anchor Attachment to Steel Pipe: Attach by welding. Comply with ASME B31.9.
2. Anchor Attachment to Copper Tubing: Attach with pipe hangers. Use MSS SP-58, Type 24; U bolts bolted to anchor.

F. Fabricate and install steel anchors by welding steel shapes, plates, and bars. Comply with ASME B31.9 and AWS D1.1/D1.1M.

1. Anchor Attachment to Steel Structural Members: Attach by welding.
2. Anchor Attachment to Concrete Structural Members: Attach by fasteners. Follow fastener manufacturer's written instructions.
3. Use grout to form flat bearing surfaces for guides and anchors attached to concrete.

3.5 INSTALLATION OF PIPE LOOP AND SWING CONNECTIONS

A. Install pipe loops cold-sprung in tension or compression as required to partly absorb tension or compression produced during anticipated change in temperature.

B. Connect risers and branch connections to mains with at least five pipe fittings, including tee in main.

C. Connect risers and branch connections to terminal units with at least four pipe fittings, including tee in riser.

D. Connect mains and branch connections to terminal units with at least four pipe fittings, including tee in main.

3.6 INSTALLATION OF SLEEVES - GENERAL

A. Install sleeves for piping passing through penetrations in floors, partitions, roofs, and walls.

B. For sleeves that will have sleeve-seal system installed, select sleeves of size large enough to provide 1-inch annular clear space between piping and concrete slabs and walls.

1. Sleeves are not required for core-drilled holes.

C. Install sleeves in concrete floors, concrete roof slabs, and concrete walls as new slabs and walls are constructed.

1. Permanent sleeves are not required for holes in slabs formed by molded-PE or -PP sleeves.
2. Cut sleeves to length for mounting flush with both surfaces.

a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches above finished floor level.

3. Using grout or silicone sealant, seal the space outside of sleeves in floors/slabs/walls without sleeve-seal system. Select to maintain fire resistance of floor/slab/wall.

D. Install sleeves for pipes passing through interior partitions.

1. Cut sleeves to length for mounting flush with both surfaces.
2. Install sleeves that are large enough to provide **1/4-inch** annular clear space between sleeve and pipe or pipe insulation.
3. Seal annular space between sleeve and piping or piping insulation; use joint sealants that joint sealant manufacturer's literature indicates is appropriate for size, depth, and location of joint.

E. Fire-Resistance-Rated Penetrations, Horizontal Assembly Penetrations, and Smoke Barrier Penetrations: Maintain indicated fire or smoke rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with fire- and smoke-stop materials. Comply with requirements for firestopping and fill materials specified in Section 078413 "Penetration Firestopping."

3.7 INSTALLATION OF SLEEVES WITH WATERSTOP

A. Install sleeve with waterstop as new walls and slabs are constructed.

B. Assemble fitting components of length to be flush with both surfaces of concrete slabs and walls. Position waterstop flange centered across width of concrete slab or wall.

C. Secure nailing flanges to wooden concrete forms.

D. Using grout or, seal space around outside of sleeves. Select to maintain fire resistance of floor/slab/wall.

3.8 INSTALLATION OF STACK-SLEEVE FITTINGS

A. Install stack-sleeve fittings in new slabs as slabs are constructed.

1. Install fittings that are large enough to provide **1/4-inch** annular clear space between sleeve and pipe or pipe insulation.
2. Secure flashing between clamping flanges for pipes penetrating floors with membrane waterproofing. Comply with requirements for flashing specified in Section 076200 "Sheet Metal Flashing and Trim."
3. Install section of cast-iron soil pipe to extend sleeve to **2 inches** above finished floor level.
4. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified.
5. Using silicone sealant, seal space between top hub of stack-sleeve fitting and pipe.

B. Fire-Resistance-Rated Penetrations, Horizontal Assembly Penetrations, and Smoke Barrier Penetrations: Maintain indicated fire or smoke rating of floors at pipe penetrations. Seal pipe penetrations with fire- and smoke-stop materials. Comply with requirements for firestopping specified in Section 078413 "Penetration Firestopping."

3.9 INSTALLATION OF SLEEVE-SEAL SYSTEMS

A. Install sleeve-seal systems in sleeves in exterior concrete walls and slabs-on-grade at service piping entries into building, and passing through exterior walls.

B. Select type, size, and number of sealing elements required for piping material and size and for sleeve ID or hole size. Assemble sleeve-seal system components, and install in annular space between piping and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make a watertight seal.

3.10 INSTALLATION OF ESCUTCHEONS

A. Install escutcheons for piping penetrations of walls, ceilings, and finished floors.

B. Install escutcheons with ID to closely fit around pipe, tube, and insulation of insulated piping and with OD that completely covers opening.

3.11 INSTALLATION OF METERS AND GAUGES

A. Install thermometer with thermowell at each required thermometer location.

B. Install thermowells in vertical position in piping tees.

C. Install thermowells of sizes required to match thermometer connectors. Include bushings if required to match sizes.

D. Install thermowells with extension on insulated piping.

E. Fill thermowells with heat-transfer medium.

F. Install direct-mounted thermometers in thermowells and adjust vertical and tilted positions.

G. Install remote-mounted thermometer bulbs in thermowells and install cases on panels; connect cases with tubing and support tubing to prevent kinks.

H. Install direct-mounted pressure gauges in piping tees with pressure gauge located on pipe at most readable position.

I. Install remote-mounted pressure gauges on panel.

J. Install valve and snubber in piping for each pressure gauge for fluids.

K. Install test plugs in piping tees.

L. Install thermometers in the following locations:

1. Inlet and outlet of each water heater.
2. Inlets and outlets of each domestic water heat exchanger.
3. Inlet and outlet of each domestic hot-water storage tank.

4. Inlet and outlet of each remote domestic water chiller.
5. Outlet side of hot-water-balancing valve.
6. Each main hot-water-recirculating line return pipe.

M. Install pressure gauges in the following locations:

1. Building water service entrance into building.
2. Inlet and outlet of each pressure-reducing valve.
3. Suction and discharge of each domestic water pump.

3.12 CONNECTIONS

A. Install meters and gauges adjacent to machines and equipment to allow space for service and maintenance of meters, gauges, machines, and equipment.

3.13 ADJUSTING

A. After installation, calibrate meters according to manufacturer's written instructions.

B. Adjust faces of meters and gauges to proper angle for best visibility.

3.14 FIELD QUALITY CONTROL

A. Sleeves and Sleeve Seals:

1. Perform the following tests and inspections:

a. Leak Test: After allowing for a full cure, test sleeves and sleeve seals for leaks. Repair leaks and retest until no leaks exist.
b. Sleeves and sleeve seals will be considered defective if they do not pass tests and inspections.

2. Prepare test and inspection reports.

B. Escutcheons:

1. Using new materials, replace broken and damaged escutcheons and floor plates.

3.15 SLEEVES APPLICATION

A. Use sleeves and sleeve seals for the following piping-penetration applications:

1. Exterior Concrete Walls above and below Grade:

a. Sleeves with waterstops.

1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.

2. Concrete Slabs-on-Grade:

    a. Sleeves with waterstops.

        1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.

3. Concrete Slabs above Grade:

    a. Sleeves with waterstops or stack-sleeve fittings.

4. Interior Wall and Partitions:

    a. Sleeves without waterstops.

3.16 ESCUTCHEONS APPLICATION

A. Escutcheons for New Piping and Relocated Existing Piping:

1. Piping with Fitting or Sleeve Protruding from Wall: One piece, deep pattern.
2. Chrome-Plated Piping: One piece, steel cast brass or split-casting brass with polished, chrome-plated finish.
3. Insulated Piping:

    a. One piece, steel with polished, chrome-plated finish.
    b. One piece, stainless steel with polished stainless steel finish.
    c. One piece, cast brass with polished, chrome-plated finish.
    d. One piece, stamped steel or split plate, stamped steel with concealed hinge with polished, chrome-plated finish.

4. Bare Piping at Wall and Floor Penetrations in Finished Spaces:

    a. One piece, steel with polished, chrome-plated finish.
    b. One piece, stainless steel with polished stainless steel finish.
    c. One piece, cast brass with polished, chrome-plated finish.
    d. One piece, stamped steel or split plate, stamped steel with concealed hinge with polished, chrome-plated finish.

5. Bare Piping at Ceiling Penetrations in Finished Spaces:

    a. One piece, steel with polished, chrome-plated finish.
    b. One piece, stainless steel with polished stainless steel finish.
    c. One piece, cast brass with polished, chrome-plated finish.
    d. One piece, stamped steel or split plate, stamped steel with concealed hinge with polished, chrome-plated finish.

6. Bare Piping in Unfinished Service Spaces:

    a. One piece, steel with polished, chrome-plated finish.
    b. One piece, cast brass with polished, chrome-plated finish.
    c. One piece, stamped steel or split plate, stamped steel with concealed

hinge with polished, chrome-plated finish.

7. Bare Piping in Equipment Rooms:

   a. One piece, steel with polished, chrome-plated finish.
   b. One piece, cast brass with polished, chrome-plated finish.
   c. One piece, stamped steel or split plate, stamped steel with concealed hinge with polished, chrome-plated finish.

B. Escutcheons for Existing Piping to Remain:

1. Chrome-Plated Piping: Split casting, stamped steel with concealed hinge with polished, chrome-plated finish.
2. Insulated Piping: Split plate, stamped steel with concealed hinge with polished, chrome-plated finish
3. Bare Piping at Wall and Floor Penetrations in Finished Spaces: Split plate, stamped steel with concealed hinge with polished, chrome-plated finish.
4. Bare Piping at Ceiling Penetrations in Finished Spaces: Split plate, stamped steel with concealed hinge with polished, chrome-plated finish.
5. Bare Piping in Unfinished Service Spaces: Split plate, stamped steel with concealed hinge with polished, chrome-plated finish.
6. Bare Piping in Equipment Rooms: Split plate, stamped steel with concealed hinge with polished, chrome-plated finish.

C. Install floor plates for piping penetrations of equipment-room floors.

D. Install floor plates with ID to closely fit around pipe, tube, and insulation of piping and with OD that completely covers opening.

1. New Piping and Relocated Existing Piping: One piece, floor plate.
2. Existing Piping: Split floor plate.

3.17 THERMOMETER, LEAD FREE, APPLICATION

A. Thermometers at inlet and outlet of each domestic water heater are to be the following:

1. Liquid-filled, bimetallic-actuated type.
2. Direct -mounted, metal -case, vapor-actuated type.
3. Metal case, compact -style, liquid-in-glass type.
4. Direct -mounted, light-activated type.
5. Test plug with EPDM self-sealing rubber inserts.

B. Thermometers at inlets and outlets of each domestic water heat exchanger are to be the following:

1. Liquid-filled, bimetallic-actuated type.
2. Direct -mounted, metal -case, vapor-actuated type.
3. Metal case, compact -style, liquid-in-glass type.
4. Direct -mounted, light-activated type.
5. Test plug with EPDM self-sealing rubber inserts.

C. Thermometers at inlet and outlet of each domestic hot-water storage tank are to be the following:

1. Liquid-filled, bimetallic-actuated type.
2. Direct -mounted, metal -case, vapor-actuated type.
3. Metal case, compact -style, liquid-in-glass type.
4. Direct -mounted, light-activated type.
5. Test plug with EPDM self-sealing rubber inserts.

D. Thermometers at inlet and outlet of each remote domestic water chiller are to be the following:

1. Liquid-filled, bimetallic-actuated type.
2. Direct -mounted, metal -case, vapor-actuated type.
3. Metal case, compact -style, liquid-in-glass type.
4. Direct -mounted, light-activated type.
5. Test plug with EPDM self-sealing rubber inserts.

E. Thermometer stems are to be of length to match thermowell insertion length.

3.18 THERMOMETER, LEAD FREE, SCALE-RANGE APPLICATION

A. Scale Range for Domestic Cold-Water Piping:

1. 0 to 100 deg F.
2. 0 to 150 deg F.
3. 30 to 240 deg F.

B. Scale Range for Domestic Hot-Water Piping:

1. 0 to 250 deg F.
2. 20 to 240 deg F.
3. 30 to 240 deg F.

C. Scale Range for Domestic Cooled-Water Piping:

1. 0 to 100 deg F.
2. 0 to 150 deg F.

D. Insert additional paragraphs for thermometer scale ranges and applications.

3.19 PRESSURE-GAUGE APPLICATION

A. Pressure gauges at discharge of each water service into building are to be the following:

1. Liquid filled Sealed, direct mounted, metal case.
2. Sealed, direct mounted, plastic case.
3. Test plug with EPDM self-sealing rubber inserts.

B. Pressure gauges at inlet and outlet of each water pressure-reducing valve are to be the following:

1. Liquid filled Sealed, direct mounted, metal case.
2. Sealed, direct mounted, plastic case.
3. Test plug with EPDM self-sealing rubber inserts.

C. Pressure gauges at suction and discharge of each domestic water pump are to be the following:

1. Liquid filled Sealed, direct mounted, metal case.
2. Sealed, direct mounted, plastic case.
3. Test plug with EPDM self-sealing rubber inserts.

3.20 PRESSURE-GAUGE SCALE-RANGE APPLICATION

A. Scale Range for Water Service Piping:

1. 0 to 100 psi.
2. 0 to 160 psi.
3. 0 to 200 psi.

B. Scale Range for Domestic Water Piping:

1. 0 to 100 psi.
2. 0 to 160 psi.
3. 0 to 200 psi.
4. 0 to 300 psi.

END OF SECTION 22 05 00

SECTION 22 05 23 - GENERAL-DUTY VALVES FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Ball valves.
2. Butterfly valves.
3. Check valves.
4. Gate valves.
5. Chainwheels.

1.2 DEFINITIONS

A. CWP: Cold working pressure.

B. EPDM: Ethylene propylene-diene terpolymer.

C. FKM: Fluoroelastomer.

D. NBR: Nitrile butadiene rubber (also known as Buna-N).

E. NRS: Nonrising stem.

F. OS&Y: Outside screw and yoke.

G. PTFE: Polytetrafluoroethylene.

H. RPTFE: Reinforced polytetrafluoroethylene.

I. RS: Rising stem.

1.3 ACTION SUBMITTALS

A. Product Data:

1. For each type of product.

a. Include material descriptions and dimensions of individual components.
b. Include operating characteristics and furnished accessories.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Prepare valves for shipping as follows:

1. Protect internal parts against rust and corrosion.
2. Protect threads, flange faces, grooved ends, press ends, solder ends, and weld ends.
3. Set ball valves open to minimize exposure of functional surfaces.
4. Set butterfly valves closed or slightly open.
5. Block check valves in either closed or open position.
6. Set gate valves closed to prevent rattling.

B. Use the following precautions during storage:

1. Maintain valve end protection.
2. Store valves indoors and maintain at higher-than-ambient-dew-point temperature. If outdoor storage is necessary, store valves off the ground in watertight enclosures.

C. Use sling to handle large valves; rig sling to avoid damage to exposed parts. Do not use operating handles or stems or other components as lifting or rigging points unless specifically indicated for this purpose in manufacturer's written instructions.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Standards:

1. Domestic-water piping valves intended to convey or dispense water for human consumption must comply with the U.S. Safe Drinking Water Act (SDWA), requirements of authorities having jurisdiction, and NSF 61/NSF 372; or to be certified in compliance with NSF 61/NSF 372 by an American National Standards Institute (ANSI)-accredited third-party certification body, that the weighted average lead content at wetted surfaces is less than or equal to 0.25 percent.

B. ASME Compliance:

1. ASME B1.20.1 for threads for threaded-end valves.
2. ASME B16.1 for flanges on iron valves.
3. ASME B16.5 for flanges on steel valves.
4. ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.
5. ASME B16.18 for cast-copper solder-joint connections.
6. ASME B16.22 for wrought-copper solder-joint connections.
7. ASME B16.34 for flanged- and threaded-end connections.
8. ASME B16.51 for press joint connections.
9. ASME B31.9 for building services piping valves.

C. AWWA Compliance: Comply with AWWA C606 for grooved-end connections.

D. Provide bronze valves made with dezincification-resistant materials. Bronze valves made with copper alloy (brass) containing more than 15 percent zinc are unacceptable.

E. Valve Pressure-Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.

F. Valve Sizes: Same as upstream piping unless otherwise indicated.

G. Valve Bypass and Drain Connections: MSS SP-45.

H. Valve Actuator Type:

1. Gear Actuator: For quarter-turn ball valves NPS 4 and larger.
2. Hand Lever: For quarter-turn ball valves smaller than NPS 4.

I. Valves in Insulated Piping:

1. Provide **2-inch** extended neck stems.
2. Provide extended operating handles with nonthermal-conductive covering material and protective sleeves that allow operation of valves without breaking vapor seals or disturbing insulation.
3. Provide memory stops that are fully adjustable after insulation is applied.

2.2 BALL VALVES, LEAD FREE

A. Ball Valves, Lead Free, Threaded Ends - Brass, One Piece:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Bonomi North America, Inc.
b. KITZ Corporation
c. WATTS; A Watts Water Technologies Company

2. Basis-of-Design Product: Subject to compliance with requirements, provide valve or comparable product by one of the following:

a. Bonomi North America, Inc.
b. KITZ Corporation
c. WATTS; A Watts Water Technologies Company

3. Standards: MSS SP-110 and MSS SP-145.
4. CWP Rating: **400 psig**.
5. Body Design: One piece.
6. Body Material: Forged brass or bronze.
7. Ends: Threaded.
8. Seats: PTFE.
9. Stem: Brass or stainless steel.
10. Ball: Chrome-plated brass or stainless steel.
11. Port: Reduced.

B. Ball Valves, Lead Free, Threaded or Soldered Ends - Brass, Two Piece with Full Port

and Brass Trim:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

    a. A.Y. McDonald Mfg. Co.
    b. American Valve, Inc
    c. Apollo Valves; a part of Aalberts Integrated Piping Systems
    d. Bonomi North America, Inc.
    e. Center Line; a Crane Co. brand
    f. DynaQuip Controls
    g. FNW; Ferguson Enterprises, Inc.
    h. Hammond Valve
    i. Jenkins Valves; a Crane Co. brand
    j. Jomar Valve
    k. KITZ Corporation
    l. Lance Valves
    m. Marwin Valve; Richards Industries
    n. Milwaukee Valve Company
    o. Mueller Streamline Co.; a company of Mueller Industries
    p. Red-White Valve Corp.
    q. Stockham; a Crane Co. brand
    r. Viega LLC
    s. WATTS; A Watts Water Technologies Company

2. Basis-of-Design Product: Subject to compliance with requirements, provide valve or comparable product by one of the following:

    a. A.Y. McDonald Mfg. Co.
    b. American Valve, Inc
    c. Apollo Valves; a part of Aalberts Integrated Piping Systems
    d. Bonomi North America, Inc.
    e. Center Line; a Crane Co. brand
    f. DynaQuip Controls
    g. FNW; Ferguson Enterprises, Inc.
    h. Hammond Valve
    i. Jenkins Valves; a Crane Co. brand
    j. Jomar Valve
    k. KITZ Corporation
    l. Lance Valves
    m. Marwin Valve; Richards Industries
    n. Milwaukee Valve Company
    o. Mueller Streamline Co.; a company of Mueller Industries
    p. Red-White Valve Corp.
    q. Stockham; a Crane Co. brand
    r. Viega LLC
    s. WATTS; A Watts Water Technologies Company

3. Standards: MSS SP-110 and MSS SP-145.
4. CWP Rating: **600 psig**.

5. Body Design: Two piece.
6. Body Material: Forged brass.
7. Ends: Threaded or soldered. See Part 3 ball valve schedule articles.
8. Seats: PTFE.
9. Stem: Brass.
10. Ball: Chrome-plated brass.
11. Port: Full.

C. Ball Valves, Lead Free, Press Ends - Brass, Two Piece with Full Port and Brass Trim:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

    a. American Valve, Inc
    b. Apollo Valves; a part of Aalberts Integrated Piping Systems
    c. Bonomi North America, Inc.
    d. Crane Fluid Systems; Crane Co.
    e. Hammond Valve
    f. Jenkins Valves; a Crane Co. brand
    g. Jomar Valve
    h. KITZ Corporation
    i. Lance Valves
    j. Milwaukee Valve Company
    k. Stockham; a Crane Co. brand
    l. Viega LLC
    m. WATTS; A Watts Water Technologies Company

2. Basis-of-Design Product: Subject to compliance with requirements, provide ball valve or comparable product by one of the following:

    a. American Valve, Inc
    b. Apollo Valves; a part of Aalberts Integrated Piping Systems
    c. Bonomi North America, Inc.
    d. Crane Fluid Systems; Crane Co.
    e. Hammond Valve
    f. Jenkins Valves; a Crane Co. brand
    g. Jomar Valve
    h. KITZ Corporation
    i. Lance Valves
    j. Milwaukee Valve Company
    k. Stockham; a Crane Co. brand
    l. Viega LLC
    m. WATTS; A Watts Water Technologies Company

3. Standards: MSS SP-110, MSS SP-145, IAPMO/ANSI Z1157.
4. CWP Rating: Minimum **200 psig**.
5. Body Design: Two piece.
6. Body Material: Forged brass.
7. Ends: Press.
8. Press-End Connections Rating: Minimum **200 psig**.

9. Seats: PTFE or RPTFE.
10. Stem: Brass.
11. Ball: Chrome-plated brass.
12. Port: Full.
13. O-Ring Seal: NBR or EPDM.

D. Ball Valves, Lead Free, Threaded or Soldered Ends - Brass, Two Piece with Full Port and Stainless Steel Trim:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

    a. A.Y. McDonald Mfg. Co.
    b. American Valve, Inc
    c. Apollo Valves; a part of Aalberts Integrated Piping Systems
    d. Hammond Valve
    e. Jenkins Valves; a Crane Co. brand
    f. Jomar Valve
    g. KITZ Corporation
    h. Lance Valves
    i. Marwin Valve; Richards Industries
    j. Milwaukee Valve Company
    k. Red-White Valve Corp.
    l. Stockham; a Crane Co. brand
    m. Viega LLC
    n. WATTS; A Watts Water Technologies Company

2. Basis-of-Design Product: Subject to compliance with requirements, provide ball valve or comparable product by one of the following:

    a. A.Y. McDonald Mfg. Co.
    b. American Valve, Inc
    c. Apollo Valves; a part of Aalberts Integrated Piping Systems
    d. Hammond Valve
    e. Jenkins Valves; a Crane Co. brand
    f. Jomar Valve
    g. KITZ Corporation
    h. Lance Valves
    i. Marwin Valve; Richards Industries
    j. Milwaukee Valve Company
    k. Red-White Valve Corp.
    l. Stockham; a Crane Co. brand
    m. Viega LLC
    n. WATTS; A Watts Water Technologies Company

3. Standards: MSS SP-110 and MSS SP-145.
4. CWP Rating: **600 psig**.
5. Body Design: Two piece.
6. Body Material: Forged brass.
7. Ends: Threaded or soldered. See Part 3 ball valve schedule articles.

8. Seats: PTFE.
9. Stem: Stainless steel.
10. Ball: Stainless steel, vented.
11. Port: Full.

E. Ball Valves, Lead Free, Press Ends - Brass, Two Piece with Full Port and Stainless Steel Trim:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

    a. American Valve, Inc
    b. Apollo Valves; a part of Aalberts Integrated Piping Systems
    c. Center Line; a Crane Co. brand
    d. Hammond Valve
    e. Jomar Valve
    f. Lance Valves
    g. Milwaukee Valve Company
    h. NIBCO INC.
    i. Red-White Valve Corp.
    j. Stockham; a Crane Co. brand
    k. Viega LLC
    l. WATTS; A Watts Water Technologies Company

2. Basis-of-Design Product: Subject to compliance with requirements, provide ball valve or comparable product by one of the following:

    a. American Valve, Inc
    b. Apollo Valves; a part of Aalberts Integrated Piping Systems
    c. Center Line; a Crane Co. brand
    d. Hammond Valve
    e. Jomar Valve
    f. Lance Valves
    g. Milwaukee Valve Company
    h. NIBCO INC.
    i. Red-White Valve Corp.
    j. Stockham; a Crane Co. brand
    k. Viega LLC
    l. WATTS; A Watts Water Technologies Company

3. Standards: MSS SP-110, MSS SP-145, and IAPMO/ANSI Z1157.
4. CWP Rating: Minimum **200 psig**.
5. Body Design: Two piece.
6. Body Material: Forged brass.
7. Ends: Press.
8. Press-End Connections Rating: Minimum **200 psig**.
9. Seats: PTFE or RPTFE.
10. Stem: Stainless steel.
11. Ball: Stainless steel, vented.
12. Port: Full.

13. O-Ring Seal: NBR or EPDM.

F. Ball Valves, Lead Free, Threaded or Soldered Ends - Brass, Two Piece with Regular Port and Brass Trim:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

    a. A.Y. McDonald Mfg. Co.
    b. American Valve, Inc
    c. Apollo Valves; a part of Aalberts Integrated Piping Systems
    d. Center Line; a Crane Co. brand
    e. FNW; Ferguson Enterprises, Inc.
    f. Hammond Valve
    g. Jomar Valve
    h. KITZ Corporation
    i. Lance Valves
    j. Milwaukee Valve Company
    k. Red-White Valve Corp.
    l. Stockham; a Crane Co. brand
    m. Viega LLC
    n. WATTS; A Watts Water Technologies Company

2. Basis-of-Design Product: Subject to compliance with requirements, provide ball valve or comparable product by one of the following:

    a. A.Y. McDonald Mfg. Co.
    b. American Valve, Inc
    c. Apollo Valves; a part of Aalberts Integrated Piping Systems
    d. Center Line; a Crane Co. brand
    e. FNW; Ferguson Enterprises, Inc.
    f. Hammond Valve
    g. Jomar Valve
    h. KITZ Corporation
    i. Lance Valves
    j. Milwaukee Valve Company
    k. Red-White Valve Corp.
    l. Stockham; a Crane Co. brand
    m. Viega LLC
    n. WATTS; A Watts Water Technologies Company

3. Standards: MSS SP-110 and MSS SP-145.
4. CWP Rating: **600 psig**.
5. Body Design: Two piece.
6. Body Material: Forged brass.
7. Ends: Threaded or soldered. See Part 3 ball valve schedule articles.
8. Seats: PTFE.
9. Stem: Brass.
10. Ball: Chrome-plated brass.
11. Port: Regular.

G. Ball Valves, Lead Free, Threaded or Soldered Ends - Brass, Two Piece with Regular Port and Stainless Steel Trim:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

    a. A.Y. McDonald Mfg. Co.
    b. American Valve, Inc
    c. Apollo Valves; a part of Aalberts Integrated Piping Systems
    d. Center Line; a Crane Co. brand
    e. Hammond Valve
    f. Jomar Valve
    g. KITZ Corporation
    h. Lance Valves
    i. Marwin Valve; Richards Industries
    j. Milwaukee Valve Company
    k. Neles Corporation
    l. Red-White Valve Corp.
    m. Stockham; a Crane Co. brand
    n. Viega LLC
    o. WATTS; A Watts Water Technologies Company

2. Basis-of-Design Product: Subject to compliance with requirements, provide ball valve or comparable product by one of the following:

    a. A.Y. McDonald Mfg. Co.
    b. American Valve, Inc
    c. Apollo Valves; a part of Aalberts Integrated Piping Systems
    d. Center Line; a Crane Co. brand
    e. Hammond Valve
    f. Jomar Valve
    g. KITZ Corporation
    h. Lance Valves
    i. Marwin Valve; Richards Industries
    j. Milwaukee Valve Company
    k. Neles Corporation
    l. Red-White Valve Corp.
    m. Stockham; a Crane Co. brand
    n. Viega LLC
    o. WATTS; A Watts Water Technologies Company

3. Standards: MSS SP-110 and MSS SP-145.
4. CWP Rating: **600 psig**.
5. Body Design: Two piece.
6. Body Material: Brass or bronze.
7. Ends: Threaded or soldered. See Part 3 ball valve schedule articles.
8. Seats: PTFE.
9. Stem: Stainless steel.
10. Ball: Stainless steel, vented.
11. Port: Regular.

H. Ball Valves, Lead Free, Threaded or Soldered Ends - Brass, Three Piece with Full Port and Brass Trim:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

    a. Bonomi North America, Inc.
    b. Jomar Valve
    c. Marwin Valve; Richards Industries
    d. WATTS; A Watts Water Technologies Company

2. Basis-of-Design Product: Subject to compliance with requirements, provide valve or comparable product by one of the following:

    a. Bonomi North America, Inc.
    b. Jomar Valve
    c. Marwin Valve; Richards Industries
    d. WATTS; A Watts Water Technologies Company

3. Standards: MSS SP-110 and MSS SP-145.
4. CWP Rating: **600 psig**.
5. Body Design: Three piece.
6. Body Material: Forged brass.
7. Ends: Threaded or soldered. See Part 3 ball valve schedule articles.
8. Seats: PTFE.
9. Stem: Brass.
10. Ball: Chrome-plated brass.
11. Port: Full.

I. Ball Valves, Lead Free, Threaded or Soldered Ends - Brass, Three Piece with Full Port and Stainless Steel Trim:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

    a. DynaQuip Controls
    b. Marwin Valve; Richards Industries

2. Basis-of-Design Product: Subject to compliance with requirements, provide ball valve or comparable product by one of the following:

    a. DynaQuip Controls
    b. Marwin Valve; Richards Industries

3. Standards: MSS SP-110 and MSS SP-145.
4. CWP Rating: **600 psig**.
5. Body Design: Three piece.
6. Body Material: Forged brass.
7. Ends: Threaded or soldered. See Part 3 ball valve schedule articles.

8. Seats: PTFE.
9. Stem: Stainless steel.
10. Ball: Stainless steel, vented.
11. Port: Full.

J. Ball Valves, Lead Free, Threaded Ends - Bronze, One Piece with Bronze Trim:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

    a. NIBCO INC.
    b. WATTS; A Watts Water Technologies Company
    c. Zurn Industries, LLC

2. Basis-of-Design Product: Subject to compliance with requirements, provide ball valve or comparable product by one of the following:

    a. NIBCO INC.
    b. WATTS; A Watts Water Technologies Company
    c. Zurn Industries, LLC

3. Standards: MSS SP-110 and MSS SP-145.
4. CWP Rating: **400 psig**.
5. Body Design: One piece.
6. Body Material: Bronze.
7. Ends: Threaded.
8. Seats: PTFE.
9. Stem: Bronze.
10. Ball: Chrome-plated brass.
11. Port: Reduced.

K. Ball Valves, Lead Free, Threaded Ends - Bronze, One Piece with Stainless Steel Trim:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

    a. NIBCO INC.
    b. WATTS; A Watts Water Technologies Company

2. Basis-of-Design Product: Subject to compliance with requirements, provide ball valve or comparable product by one of the following:

    a. NIBCO INC.
    b. WATTS; A Watts Water Technologies Company

3. Standards: MSS SP-110 and MSS SP-145.
4. CWP Rating: **600 psig**.
5. Body Design: One piece.
6. Body Material: Bronze.

7. Ends: Threaded.
8. Seats: PTFE.
9. Stem: Stainless steel.
10. Ball: Stainless steel, vented.
11. Port: Reduced.

L. Ball Valves, Lead Free, Threaded or Soldered Ends - Bronze, Two Piece with Full Port and Bronze or Brass Trim:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

    a. Apollo Valves; a part of Aalberts Integrated Piping Systems
    b. Bonomi North America, Inc.
    c. Center Line; a Crane Co. brand
    d. Hammond Valve
    e. Jenkins Valves; a Crane Co. brand
    f. Milwaukee Valve Company
    g. NIBCO INC.
    h. Red-White Valve Corp.
    i. Stockham; a Crane Co. brand
    j. Viega LLC
    k. WATTS; A Watts Water Technologies Company
    l. Zurn Industries, LLC

2. Basis-of-Design Product: Subject to compliance with requirements, provide ball valve or comparable product by one of the following:

    a. Apollo Valves; a part of Aalberts Integrated Piping Systems
    b. Bonomi North America, Inc.
    c. Center Line; a Crane Co. brand
    d. Hammond Valve
    e. Jenkins Valves; a Crane Co. brand
    f. Milwaukee Valve Company
    g. NIBCO INC.
    h. Red-White Valve Corp.
    i. Stockham; a Crane Co. brand
    j. Viega LLC
    k. WATTS; A Watts Water Technologies Company
    l. Zurn Industries, LLC

3. Standards: MSS SP-110 and MSS SP-145.
4. CWP Rating: **600 psig**.
5. Body Design: Two piece.
6. Body Material: Bronze.
7. Ends: Threaded or soldered. See Part 3 ball valve schedule articles.
8. Seats: PTFE.
9. Stem: Bronze or brass.
10. Ball: Chrome-plated brass.
11. Port: Full.

M. Ball Valves, Lead Free, Press Ends - Bronze, Two Piece with Full Port and Bronze or Brass Trim:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

    a. Apollo Valves; a part of Aalberts Integrated Piping Systems
    b. Center Line; a Crane Co. brand
    c. Hammond Valve
    d. Milwaukee Valve Company
    e. NIBCO INC.
    f. Red-White Valve Corp.
    g. Stockham; a Crane Co. brand
    h. Viega LLC
    i. Zurn Industries, LLC

2. Basis-of-Design Product: Subject to compliance with requirements, provide ball valve or comparable product by one of the following:

    a. Apollo Valves; a part of Aalberts Integrated Piping Systems
    b. Center Line; a Crane Co. brand
    c. Hammond Valve
    d. Milwaukee Valve Company
    e. NIBCO INC.
    f. Red-White Valve Corp.
    g. Stockham; a Crane Co. brand
    h. Viega LLC
    i. Zurn Industries, LLC

3. Standards: MSS SP-110, MSS SP-145, and IAPMO/ANSI Z1157.
4. CWP Rating: Minimum **200 psig**.
5. Body Design: Two piece.
6. Body Material: Bronze.
7. Ends: Press.
8. Press-End Connections Rating: Minimum **200 psig**.
9. Seats: PTFE or RTPFE.
10. Stem: Bronze or brass.
11. Ball: Chrome-plated brass.
12. Port: Full.
13. O-Ring Seal: EPDM or NBR.

N. Ball Valves, Lead Free, Threaded or Soldered Ends - Bronze, Two Piece with Full Port and Stainless Steel Trim:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

    a. Apollo Valves; a part of Aalberts Integrated Piping Systems
    b. Center Line; a Crane Co. brand

c. DynaQuip Controls
d. Hammond Valve
e. Jenkins Valves; a Crane Co. brand
f. Milwaukee Valve Company
g. NIBCO INC.
h. Red-White Valve Corp.
i. Stockham; a Crane Co. brand
j. Viega LLC
k. WATTS; A Watts Water Technologies Company

2. Basis-of-Design Product: Subject to compliance with requirements, provide Insert manufacturer's name; product name or designation or comparable product by one of the following:

a. Apollo Valves; a part of Aalberts Integrated Piping Systems
b. Center Line; a Crane Co. brand
c. DynaQuip Controls
d. Hammond Valve
e. Jenkins Valves; a Crane Co. brand
f. Milwaukee Valve Company
g. NIBCO INC.
h. Red-White Valve Corp.
i. Stockham; a Crane Co. brand
j. Viega LLC
k. WATTS; A Watts Water Technologies Company

3. Standards: MSS SP-110 and MSS SP-145.
4. CWP Rating: **600 psig**.
5. Body Design: Two piece.
6. Body Material: Bronze.
7. Ends: Threaded or soldered. See Part 3 ball valve schedule articles.
8. Seats: PTFE.
9. Stem: Stainless steel.
10. Ball: Stainless steel, vented.
11. Port: Full.

O. Ball Valves, Lead Free, Threaded Ends - Bronze, Two Piece with Regular Port and Bronze or Brass Trim:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. American Valve, Inc
b. Apollo Valves; a part of Aalberts Integrated Piping Systems
c. Center Line; a Crane Co. brand
d. DynaQuip Controls
e. Hammond Valve
f. Jenkins Valves; a Crane Co. brand
g. Jomar Valve
h. Lance Valves

i. Milwaukee Valve Company
j. NIBCO INC.
k. Red-White Valve Corp.
l. Stockham; a Crane Co. brand
m. Viega LLC

2. Basis-of-Design Product: Subject to compliance with requirements, provide ball valve or comparable product by one of the following:

a. American Valve, Inc
b. Apollo Valves; a part of Aalberts Integrated Piping Systems
c. Center Line; a Crane Co. brand
d. DynaQuip Controls
e. Hammond Valve
f. Jenkins Valves; a Crane Co. brand
g. Jomar Valve
h. Lance Valves
i. Milwaukee Valve Company
j. NIBCO INC.
k. Red-White Valve Corp.
l. Stockham; a Crane Co. brand
m. Viega LLC

3. Standards: MSS SP-110 and MSS SP-145.
4. CWP Rating: **600 psig**.
5. Body Design: Two piece.
6. Body Material: Bronze.
7. Ends: Threaded.
8. Seats: PTFE.
9. Stem: Bronze or brass.
10. Ball: Chrome-plated brass.
11. Port: Regular.

P. Ball Valves, Lead Free, Threaded Ends - Bronze, Two Piece with Regular Port and Stainless Steel Trim:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Apollo Valves; a part of Aalberts Integrated Piping Systems
b. Center Line; a Crane Co. brand
c. DynaQuip Controls
d. Hammond Valve
e. Jenkins Valves; a Crane Co. brand
f. Jomar Valve
g. Milwaukee Valve Company
h. NIBCO INC.
i. Red-White Valve Corp.
j. Stockham; a Crane Co. brand
k. Viega LLC

2. Basis-of-Design Product: Subject to compliance with requirements, provide ball valve or comparable product by one of the following:

    a. Apollo Valves; a part of Aalberts Integrated Piping Systems
    b. Center Line; a Crane Co. brand
    c. DynaQuip Controls
    d. Hammond Valve
    e. Jenkins Valves; a Crane Co. brand
    f. Jomar Valve
    g. Milwaukee Valve Company
    h. NIBCO INC.
    i. Red-White Valve Corp.
    j. Stockham; a Crane Co. brand
    k. Viega LLC

3. Standards: MSS SP-110 and MSS SP-145.
4. CWP Rating: **600 psig**.
5. Body Design: Two piece.
6. Body Material: Bronze.
7. Ends: Threaded.
8. Seats: PTFE.
9. Stem: Stainless steel.
10. Ball: Stainless steel, vented.
11. Port: Regular.

Q. Ball Valves, Lead Free, Threaded Ends - Bronze, Three Piece with Full Port and Bronze or Brass Trim:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

    a. Apollo Valves; a part of Aalberts Integrated Piping Systems
    b. WATTS; A Watts Water Technologies Company

2. Basis-of-Design Product: Subject to compliance with requirements, provide ball valve or comparable product by one of the following:

    a. Apollo Valves; a part of Aalberts Integrated Piping Systems
    b. WATTS; A Watts Water Technologies Company

3. Standards: MSS SP-110 and MSS SP-145.
4. CWP Rating: **600 psig**.
5. Body Design: Three piece.
6. Body Material: Bronze.
7. Ends: Threaded.
8. Seats: PTFE.
9. Stem: Bronze or brass.
10. Ball: Chrome-plated brass.
11. Port: Full.

R. Ball Valves, Lead Free, Threaded Ends - Bronze, Three Piece with Full Port and Stainless Steel Trim:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

    a. Apollo Valves; a part of Aalberts Integrated Piping Systems
    b. DynaQuip Controls
    c. NIBCO INC.

2. Basis-of-Design Product: Subject to compliance with requirements, provide ball valve or comparable product by one of the following:

    a. Apollo Valves; a part of Aalberts Integrated Piping Systems
    b. DynaQuip Controls
    c. NIBCO INC.

3. Standards: MSS SP-110 and MSS SP-145.
4. CWP Rating: **600 psig**.
5. Body Design: Three piece.
6. Body Material: Bronze.
7. Ends: Threaded.
8. Seats: PTFE.
9. Stem: Stainless steel.
10. Ball: Stainless steel, vented.
11. Port: Full.

S. Ball Valves, Lead Free, Threaded or Soldered Ends - Bronze, Three Piece with Regular Port and Bronze or Brass Trim:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

    a. Apollo Valves; a part of Aalberts Integrated Piping Systems
    b. NIBCO INC.

2. Basis-of-Design Product: Subject to compliance with requirements, provide ball valve or comparable product by one of the following:

    a. Apollo Valves; a part of Aalberts Integrated Piping Systems
    b. NIBCO INC.

3. Standards: MSS SP-110 and MSS SP-145.
4. CWP Rating: **600 psig**.
5. Body Design: Three piece.
6. Body Material: Bronze.
7. Ends: Threaded or soldered.
8. Seats: PTFE.
9. Stem: Bronze.

10. Ball: Chrome-plated brass.
11. Port: Regular.

T. Ball Valves, Lead Free, Threaded or Soldered Ends - Bronze, Three Piece with Regular Port and Stainless Steel Trim:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

    a. Apollo Valves; a part of Aalberts Integrated Piping Systems
    b. NIBCO INC.

2. Basis-of-Design Product: Subject to compliance with requirements, provide ball valve or comparable product by one of the following:

    a. Apollo Valves; a part of Aalberts Integrated Piping Systems
    b. NIBCO INC.

3. Standards: MSS SP-110 and MSS SP-145.
4. CWP Rating: **600 psig**.
5. Body Design: Three piece.
6. Body Material: Bronze.
7. Ends: Threaded or soldered.
8. Seats: PTFE.
9. Stem: Stainless steel.
10. Ball: Stainless steel, vented.
11. Port: Regular.

U. Ball Valves, Lead Free, Flanged or Threaded Ends - Steel, with Full Port, Class 150:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

    a. Apollo Valves; a part of Aalberts Integrated Piping Systems
    b. DynaQuip Controls
    c. FNW; Ferguson Enterprises, Inc.
    d. Hammond Valve
    e. Jomar Valve
    f. Lance Valves
    g. Milwaukee Valve Company
    h. Neles Corporation
    i. NIBCO INC.
    j. Stockham; a Crane Co. brand
    k. Viega LLC
    l. WATTS; A Watts Water Technologies Company

2. Basis-of-Design Product: Subject to compliance with requirements, provide ball valve or comparable product by one of the following:

a. Apollo Valves; a part of Aalberts Integrated Piping Systems
b. DynaQuip Controls
c. FNW; Ferguson Enterprises, Inc.
d. Hammond Valve
e. Jomar Valve
f. Lance Valves
g. Milwaukee Valve Company
h. Neles Corporation
i. NIBCO INC.
j. Stockham; a Crane Co. brand
k. Viega LLC
l. WATTS; A Watts Water Technologies Company

3. Standards: MSS SP-72 and MSS SP-110.
4. CWP Rating: **285 psig**.
5. Body Design: Split body.
6. Body Material: Carbon steel, ASTM A216/A216M, Type WCB.
7. Ends: Flanged or threaded. See Part 3 ball valve schedule articles.
8. Seats: PTFE.
9. Stem: Stainless steel.
10. Ball: Stainless steel, vented.
11. Port: Full.

V. Ball Valves, Lead Free, Flanged or Threaded Ends - Steel, with Regular Port, Class 150:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Apollo Valves; a part of Aalberts Integrated Piping Systems
b. FNW; Ferguson Enterprises, Inc.
c. Hammond Valve
d. Jomar Valve
e. Lance Valves
f. Milwaukee Valve Company
g. Neles Corporation
h. NIBCO INC.
i. Stockham; a Crane Co. brand

2. Basis-of-Design Product: Subject to compliance with requirements, provide ball valve or comparable product by one of the following:

a. Apollo Valves; a part of Aalberts Integrated Piping Systems
b. FNW; Ferguson Enterprises, Inc.
c. Hammond Valve
d. Jomar Valve
e. Lance Valves
f. Milwaukee Valve Company
g. Neles Corporation
h. NIBCO INC.

i. Stockham; a Crane Co. brand

3. Standards: MSS SP-72 and MSS SP-110.
4. CWP Rating: **285 psig**.
5. Body Design: Uni-body.
6. Body Material: Carbon steel, ASTM A216/A216M, Type WCB.
7. Ends: Flanged or threaded. See Part 3 ball valve schedule articles.
8. Seats: PTFE.
9. Stem: Stainless steel.
10. Ball: Stainless steel, vented.
11. Port: Regular.

W. Ball Valves, Lead Free, Flanged or Threaded Ends - Iron, Class 125:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

   a. American Valve, Inc
   b. Apollo Valves; a part of Aalberts Integrated Piping Systems
   c. Sure Flow Equipment Inc
   d. WATTS; A Watts Water Technologies Company
   e. Zurn Industries, LLC

2. Basis-of-Design Product: Subject to compliance with requirements, provide ball valve or comparable product by one of the following:

   a. American Valve, Inc
   b. Apollo Valves; a part of Aalberts Integrated Piping Systems
   c. Sure Flow Equipment Inc
   d. WATTS; A Watts Water Technologies Company
   e. Zurn Industries, LLC

3. Standards: MSS SP-72, MSS SP-110, and MSS SP-145.
4. CWP Rating: **200 psig**.
5. Body Design: Split body.
6. Body Material: ASTM A126, gray iron.
7. Ends: Flanged or threaded. See Part 3 ball valve schedule articles.
8. Seats: PTFE.
9. Stem: Stainless steel.
10. Ball: Stainless steel.
11. Port: Full.

X. Ball Valves, Lead Free, Threaded or Flanged Ends - Stainless Steel, Two Piece with Full Port:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

   a. A.Y. McDonald Mfg. Co.

b. Apollo Valves; a part of Aalberts Integrated Piping Systems
c. Guardian Worldwide LLC.
d. Jomar Valve

2. Basis-of-Design Product: Subject to compliance with requirements, provide ball valve or comparable product by one of the following:

a. A.Y. McDonald Mfg. Co.
b. Apollo Valves; a part of Aalberts Integrated Piping Systems
c. Guardian Worldwide LLC.
d. Jomar Valve

3. Standards: MSS SP-110 and MSS SP-145.
4. CWP Rating: **200 psig**.
5. Body Design: Split body.
6. Body Material: Type 316 stainless steel.
7. Ends: Threaded or flanged. See Part 3 ball valve schedule articles.
8. Seats: PTFE.
9. Stem: Type 316 stainless steel.
10. Ball: Type 316 stainless steel.
11. Port: Full.

Y. Ball Valves, Lead Free, Press Ends - Stainless Steel, Two Piece with Full Port:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. A.Y. McDonald Mfg. Co.
b. Apollo Valves; a part of Aalberts Integrated Piping Systems
c. Jomar Valve

2. Basis-of-Design Product: Subject to compliance with requirements, provide ball valve or comparable product by one of the following:

a. A.Y. McDonald Mfg. Co.
b. Apollo Valves; a part of Aalberts Integrated Piping Systems
c. Jomar Valve

3. Standards: MSS SP-110, MSS SP-145, IAPMO PS-117, and ICC-ES LC1002.
4. CWP Rating: Minimum **200 psig**.
5. Body Design: Split body.
6. Body Material: Type 316 stainless steel.
7. Ends: Press.
8. Press-End Connections Rating: Minimum **200 psig**.
9. Seats: PTFE.
10. Stem: Type 316 stainless steel.
11. Ball: Type 316 stainless steel.
12. Port: Full.
13. O-Ring Seal: EPDM or NBR.

Z. Ball Valves - CPVC, Union Type:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

    a. American Valve, Inc
    b. Asahi/America
    c. Colonial Engineering, Inc.
    d. GF Piping Systems
    e. Hayward Flow Control; Hayward Industries, Inc.
    f. IPEX USA LLC
    g. Jomar Valve
    h. Red-White Valve Corp.
    i. Spears Manufacturing Company
    j. Thermoplastic Valves, Inc

2. Basis-of-Design Product: Subject to compliance with requirements, provide ball valve or comparable product by one of the following:

    a. American Valve, Inc
    b. Asahi/America
    c. Colonial Engineering, Inc.
    d. GF Piping Systems
    e. Hayward Flow Control; Hayward Industries, Inc.
    f. IPEX USA LLC
    g. Jomar Valve
    h. Red-White Valve Corp.
    i. Spears Manufacturing Company
    j. Thermoplastic Valves, Inc

3. Standard: MSS SP-122.
4. Pressure Rating and Temperature: **125 psig**, **150 psig**, or other pressure at **73 deg F** or other temperature. See Part 3 ball valve schedule articles.
5. Body Material: CPVC.
6. Body Design: Union type.
7. End Connections for Valves NPS 2 (DN 50) and Smaller: Detachable, socket or threaded. See Part 3 ball valve schedule articles.
8. End Connections for Valves NPS 2-1/2 to NPS 4 (DN 65 to DN 100): Detachable, socket, socket or threaded, threaded, or flanged. See Part 3 ball valve schedule articles.
9. Ball: CPVC, full port.
10. Seals: PTFE or EPDM-rubber O-rings.
11. Handle: Tee shaped.

AA. Ball Valves - CPVC, Non-Union Type:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. American Valve, Inc
b. Asahi/America
c. Colonial Engineering, Inc.
d. IPEX USA LLC
e. Jomar Valve
f. Red-White Valve Corp.
g. Spears Manufacturing Company

2. Basis-of-Design Product: Subject to compliance with requirements, provide ball valve or comparable product by one of the following:

a. American Valve, Inc
b. Asahi/America
c. Colonial Engineering, Inc.
d. IPEX USA LLC
e. Jomar Valve
f. Red-White Valve Corp.
g. Spears Manufacturing Company

3. Standard: MSS SP-122.
4. Pressure Rating and Temperature: **125 psig**, **150 psig**, or other pressure at **73 deg F**. See Part 3 ball valve schedule articles.
5. Body Material: CPVC.
6. Body Design: Non-union type.
7. End Connections: Socket or threaded.
8. Ball: CPVC, full or reduced port.
9. Seals: PTFE or EPDM-rubber O-rings.
10. Handle: Tee shaped.

BB. Ball Valves - PVC, Union Type:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. American Valve, Inc
b. Asahi/America
c. Colonial Engineering, Inc.
d. GF Piping Systems
e. Hayward Flow Control; Hayward Industries, Inc.
f. IPEX USA LLC
g. Jomar Valve
h. Red-White Valve Corp.
i. Spears Manufacturing Company
j. Thermoplastic Valves, Inc

2. Basis-of-Design Product: Subject to compliance with requirements, provide ball valve or comparable product by one of the following:

a. American Valve, Inc
b. Asahi/America

c. Colonial Engineering, Inc.
d. GF Piping Systems
e. Hayward Flow Control; Hayward Industries, Inc.
f. IPEX USA LLC
g. Jomar Valve
h. Red-White Valve Corp.
i. Spears Manufacturing Company
j. Thermoplastic Valves, Inc

3. Standard: MSS SP-122.
4. Pressure Rating and Temperature: **125 psig**, **150 psig**, or other pressure at **73 deg F** or other temperature. See Part 3 ball valve schedule articles.
5. Body Material: PVC.
6. Body Design: Union type.
7. End Connections for Valves NPS 2 (DN 50) and Smaller: Detachable, socket or threaded. See Part 3 ball valve schedule articles.
8. End Connections for Valves NPS 2-1/2 to NPS 4 (DN 65 to DN 100): Detachable union with socket, socket or threaded, threaded, or flanged. See Part 3 ball valve schedule articles.
9. Ball: PVC, full port.
10. Seals: PTFE or EPDM-rubber O-rings.
11. Handle: Tee shaped.

CC. Ball Valves - PVC, Non-Union Type:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. American Valve, Inc
b. Asahi/America
c. Colonial Engineering, Inc.
d. IPEX USA LLC
e. Jomar Valve
f. Red-White Valve Corp.
g. Spears Manufacturing Company

2. Basis-of-Design Product: Subject to compliance with requirements, provide ball valve or comparable product by one of the following:

a. American Valve, Inc
b. Asahi/America
c. Colonial Engineering, Inc.
d. IPEX USA LLC
e. Jomar Valve
f. Red-White Valve Corp.
g. Spears Manufacturing Company

3. Standard: MSS SP-122.
4. Pressure Rating and Temperature: **125 psig**, **150 psig**, or other pressure at **73 deg F** or other temperature.

5. Body Material: PVC.
6. Body Design: Non-union type.
7. End Connections: Socket or threaded.
8. Ball: PVC, full or reduced port.
9. Seals: PTFE or EPDM-rubber O-rings.
10. Handle: Tee shaped.

2.3 BALL VALVES, GENERAL PURPOSE

A. Ball Valves, Threaded or Soldered Ends - Brass, Two Piece with Full Port and Brass Trim:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

    a. A.Y. McDonald Mfg. Co.
    b. American Valve, Inc
    c. Apollo Valves; a part of Aalberts Integrated Piping Systems
    d. Center Line; a Crane Co. brand
    e. DynaQuip Controls
    f. FNW; Ferguson Enterprises, Inc.
    g. Hammond Valve
    h. Jenkins Valves; a Crane Co. brand
    i. Jomar Valve
    j. KITZ Corporation
    k. Lance Valves
    l. Legend Valve & Fitting, Inc
    m. Marwin Valve; Richards Industries
    n. Milwaukee Valve Company
    o. Red-White Valve Corp.
    p. Siemens Industry, Inc., Building Technologies Division
    q. Stockham; a Crane Co. brand
    r. Viega LLC
    s. WATTS; A Watts Water Technologies Company

2. Basis-of-Design Product: Subject to compliance with requirements, provide ball valve or comparable product by one of the following:

    a. A.Y. McDonald Mfg. Co.
    b. American Valve, Inc
    c. Apollo Valves; a part of Aalberts Integrated Piping Systems
    d. Center Line; a Crane Co. brand
    e. DynaQuip Controls
    f. FNW; Ferguson Enterprises, Inc.
    g. Hammond Valve
    h. Jenkins Valves; a Crane Co. brand
    i. Jomar Valve
    j. KITZ Corporation
    k. Lance Valves

l. Legend Valve & Fitting, Inc
m. Marwin Valve; Richards Industries
n. Milwaukee Valve Company
o. Red-White Valve Corp.
p. Siemens Industry, Inc., Building Technologies Division
q. Stockham; a Crane Co. brand
r. Viega LLC
s. WATTS; A Watts Water Technologies Company

3. Standard: MSS SP-110.
4. SWP Rating: **150 psig**.
5. CWP Rating: **600 psig**.
6. Body Design: Two piece.
7. Body Material: Forged brass.
8. Ends: Threaded or soldered. See Part 3 ball valve schedule articles.
9. Seats: PTFE.
10. Stem: Brass.
11. Ball: Chrome-plated brass.
12. Port: Full.

B. Ball Valves, Threaded or Soldered Ends - Brass, Two Piece with Full Port and Stainless Steel Trim:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. A.Y. McDonald Mfg. Co.
b. American Valve, Inc
c. Apollo Valves; a part of Aalberts Integrated Piping Systems
d. Crane Fluid Systems; Crane Co.
e. DynaQuip Controls
f. FNW; Ferguson Enterprises, Inc.
g. Hammond Valve
h. Jamesbury; a brand of Valmet
i. Jenkins Valves; a Crane Co. brand
j. Jomar Valve
k. KITZ Corporation
l. Lance Valves
m. Legend Valve & Fitting, Inc
n. Marwin Valve; Richards Industries
o. Milwaukee Valve Company
p. Red-White Valve Corp.
q. RuB Inc
r. Siemens Industry, Inc., Building Technologies Division
s. Stockham; a Crane Co. brand
t. Viega LLC
u. WATTS; A Watts Water Technologies Company

2. Basis-of-Design Product: Subject to compliance with requirements, provide ball valve or comparable product by one of the following:

a. A.Y. McDonald Mfg. Co.
b. American Valve, Inc
c. Apollo Valves; a part of Aalberts Integrated Piping Systems
d. Crane Fluid Systems; Crane Co.
e. DynaQuip Controls
f. FNW; Ferguson Enterprises, Inc.
g. Hammond Valve
h. Jamesbury; a brand of Valmet
i. Jenkins Valves; a Crane Co. brand
j. Jomar Valve
k. KITZ Corporation
l. Lance Valves
m. Legend Valve & Fitting, Inc
n. Marwin Valve; Richards Industries
o. Milwaukee Valve Company
p. Red-White Valve Corp.
q. RuB Inc
r. Siemens Industry, Inc., Building Technologies Division
s. Stockham; a Crane Co. brand
t. Viega LLC
u. WATTS; A Watts Water Technologies Company

3. Standard: MSS SP-110.
4. SWP Rating: **150 psig**.
5. CWP Rating: **600 psig**.
6. Body Design: Two piece.
7. Body Material: Forged brass.
8. Ends: Threaded or soldered. See Part 3 ball valve schedule articles.
9. Seats: PTFE.
10. Stem: Stainless steel.
11. Ball: Stainless steel, vented.
12. Port: Full.

C. Ball Valves, Threaded or Soldered Ends - Brass, Three Piece with Full Port and Brass Trim:

1. Manufacturers: Subject to compliance with requirements, provide products by the following:

   a. WATTS; A Watts Water Technologies Company

2. Basis-of-Design Product: Subject to compliance with requirements, provide ball valve or comparable product by one of the following:

   a. WATTS; A Watts Water Technologies Company

3. Standard: MSS SP-110.
4. SWP Rating: **150 psig**.
5. CWP Rating: **600 psig**.
6. Body Design: Three piece.
7. Body Material: Forged brass.

8. Ends: Threaded or soldered ends. See Part 3 ball valve schedule articles.
9. Seats: PTFE.
10. Stem: Brass.
11. Ball: Chrome-plated brass.
12. Port: Full.

D. Ball Valves, Threaded or Soldered Ends - Brass, Three Piece with Full Port and Stainless Steel Trim:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

    a. DynaQuip Controls
    b. Marwin Valve; Richards Industries
    c. WATTS; A Watts Water Technologies Company

2. Basis-of-Design Product: Subject to compliance with requirements, provide ball valve or comparable product by one of the following:

    a. DynaQuip Controls
    b. Marwin Valve; Richards Industries
    c. WATTS; A Watts Water Technologies Company

3. Standard: MSS SP-110.
4. SWP Rating: **150 psig**.
5. CWP Rating: **600 psig**.
6. Body Design: Three piece.
7. Body Material: Forged brass.
8. Ends: Threaded or soldered. See Part 3 ball valve schedule articles.
9. Seats: PTFE.
10. Stem: Stainless steel.
11. Ball: Stainless steel, vented.
12. Port: Full.

E. Ball Valves, Threaded Ends - Bronze, Two Piece, Safety Exhaust:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

    a. Apollo Valves; a part of Aalberts Integrated Piping Systems
    b. DynaQuip Controls
    c. Lance Valves

2. Basis-of-Design Product: Subject to compliance with requirements, provide ball valve or comparable product by one of the following:

    a. Apollo Valves; a part of Aalberts Integrated Piping Systems
    b. DynaQuip Controls
    c. Lance Valves

3. Standards: MSS SP-110 and MSS SP-145.
4. CWP Rating: **200 psig** or other pressure. See Part 3 ball valve schedule articles.
5. Body Design: Two piece.
6. Body Material: Bronze, ASTM B584, Alloy C844.
7. Ends: Threaded.
8. Seats: PTFE.
9. Stem: Stainless steel.
10. Ball: Chrome-plated brass, with exhaust vent opening for pneumatic applications.
11. Port: Full.

F. Ball Valves, Flanged Ends - Steel, with Full Port and Stainless Steel Trim, Class 150:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

    a. Apollo Valves; a part of Aalberts Integrated Piping Systems
    b. DynaQuip Controls
    c. FNW; Ferguson Enterprises, Inc.
    d. Hammond Valve
    e. Jamesbury; a brand of Valmet
    f. Jomar Valve
    g. Lance Valves
    h. Milwaukee Valve Company
    i. NIBCO INC.
    j. Stockham; a Crane Co. brand
    k. Viega LLC
    l. WATTS; A Watts Water Technologies Company

2. Basis-of-Design Product: Subject to compliance with requirements, provide Insert manufacturer's name; product name or designation or comparable product by one of the following:

    a. Apollo Valves; a part of Aalberts Integrated Piping Systems
    b. DynaQuip Controls
    c. FNW; Ferguson Enterprises, Inc.
    d. Hammond Valve
    e. Jamesbury; a brand of Valmet
    f. Jomar Valve
    g. Lance Valves
    h. Milwaukee Valve Company
    i. NIBCO INC.
    j. Stockham; a Crane Co. brand
    k. Viega LLC
    l. WATTS; A Watts Water Technologies Company

3. Standard: MSS SP-72.
4. CWP Rating: **285 psig**.
5. Body Design: Split body.
6. Body Material: Carbon steel, ASTM A216/A216M, Type WCB.
7. Ends: Flanged.

8. Seats: PTFE.
9. Stem: Stainless steel.
10. Ball: Stainless steel, vented.
11. Port: Full.

G. Ball Valves, Flanged Ends - Steel, with Full Port and Stainless Steel Trim, Class 300:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

    a. Apollo Valves; a part of Aalberts Integrated Piping Systems
    b. DynaQuip Controls
    c. FNW; Ferguson Enterprises, Inc.
    d. Hammond Valve
    e. Jamesbury; a brand of Valmet
    f. Jomar Valve
    g. Lance Valves
    h. Milwaukee Valve Company
    i. NIBCO INC.
    j. Stockham; a Crane Co. brand
    k. Viega LLC
    l. WATTS; A Watts Water Technologies Company

2. Basis-of-Design Product: Subject to compliance with requirements, provide ball valve or comparable product by one of the following:

    a. Apollo Valves; a part of Aalberts Integrated Piping Systems
    b. DynaQuip Controls
    c. FNW; Ferguson Enterprises, Inc.
    d. Hammond Valve
    e. Jamesbury; a brand of Valmet
    f. Jomar Valve
    g. Lance Valves
    h. Milwaukee Valve Company
    i. NIBCO INC.
    j. Stockham; a Crane Co. brand
    k. Viega LLC
    l. WATTS; A Watts Water Technologies Company

3. Standard: MSS SP-72.
4. CWP Rating: **720 psig**.
5. Body Design: Split body.
6. Body Material: Carbon steel, ASTM A216/A216M, Type WCB.
7. Ends: Flanged.
8. Seats: PTFE.
9. Stem: Stainless steel.
10. Ball: Stainless steel, vented.
11. Port: Full.

H. Ball Valves, Flanged Ends - Iron, Class 125:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

    a. American Valve, Inc
    b. Apollo Valves; a part of Aalberts Integrated Piping Systems
    c. Sure Flow Equipment Inc
    d. WATTS; A Watts Water Technologies Company

2. Basis-of-Design Product: Subject to compliance with requirements, provide ball valve or comparable product by one of the following:

    a. American Valve, Inc
    b. Apollo Valves; a part of Aalberts Integrated Piping Systems
    c. Sure Flow Equipment Inc
    d. WATTS; A Watts Water Technologies Company

3. Standard: MSS SP-72.
4. CWP Rating: **200 psig**.
5. Body Design: Split body.
6. Body Material: ASTM A126, gray iron.
7. Ends: Flanged.
8. Seats: PTFE.
9. Stem: Stainless steel.
10. Ball: Stainless steel.
11. Port: Full.

I. Ball Valves, Threaded or Flanged Ends - Stainless Steel, Two Piece with Full Port:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

    a. A.Y. McDonald Mfg. Co.
    b. Apollo Valves; a part of Aalberts Integrated Piping Systems
    c. FNW; Ferguson Enterprises, Inc.
    d. Hammond Valve
    e. Jomar Valve

2. Basis-of-Design Product: Subject to compliance with requirements, provide ball valve or comparable product by one of the following:

    a. A.Y. McDonald Mfg. Co.
    b. Apollo Valves; a part of Aalberts Integrated Piping Systems
    c. FNW; Ferguson Enterprises, Inc.
    d. Hammond Valve
    e. Jomar Valve

3. Standard: MSS SP-110.
4. CWP Rating: **200 psig**.
5. Body Design: Split body.

6. Body Material: Type 316 stainless steel.
7. Ends: Threaded or flanged. See Part 3 ball valve schedule articles.
8. Seats: PTFE.
9. Stem: Type 316 stainless steel.
10. Ball: Type 316 stainless steel.
11. Port: Full.

2.4 BUTTERFLY VALVES, LEAD FREE

A. Butterfly Valves, Lead Free, Single Flange (Lug Type) - Iron, with Aluminum-Bronze Disc:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

    a. Apollo Valves; a part of Aalberts Integrated Piping Systems
    b. FNW; Ferguson Enterprises, Inc.
    c. NIBCO INC.
    d. WATTS; A Watts Water Technologies Company
    e. Zurn Industries, LLC

2. Basis-of-Design Product: Subject to compliance with requirements, provide butterfly valve or comparable product by one of the following:

    a. Apollo Valves; a part of Aalberts Integrated Piping Systems
    b. FNW; Ferguson Enterprises, Inc.
    c. NIBCO INC.
    d. WATTS; A Watts Water Technologies Company
    e. Zurn Industries, LLC

3. Standard: MSS SP-67, Type I.
4. CWP Rating: **150 psig**, or **200 psig**. See Part 3 butterfly valve schedule articles.
5. Body Design: Single flange (lug type), suitable for bidirectional dead-end service at rated pressure without use of downstream flange.
6. Body Material: ASTM A126, cast iron or ASTM A536, ductile iron.
7. Seat: EPDM or NBR. See Part 3 butterfly valve schedule articles.
8. Stem: One- or two-piece stainless steel.
9. Disc: Aluminum bronze.

B. Butterfly Valves, Lead Free, Single Flange (Lug Type) - Iron, with Ductile-Iron Disc:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

    a. Apollo Valves; a part of Aalberts Integrated Piping Systems
    b. FNW; Ferguson Enterprises, Inc.
    c. Jenkins Valves; a Crane Co. brand
    d. NIBCO INC.

e. WATTS; A Watts Water Technologies Company
f. Zurn Industries, LLC

2. Basis-of-Design Product: Subject to compliance with requirements, provide butterfly valve or comparable product by one of the following:

a. Apollo Valves; a part of Aalberts Integrated Piping Systems
b. FNW; Ferguson Enterprises, Inc.
c. Jenkins Valves; a Crane Co. brand
d. NIBCO INC.
e. WATTS; A Watts Water Technologies Company
f. Zurn Industries, LLC

3. Standard: MSS SP-67, Type I.
4. CWP Rating: **150 psig**, or **200 psig**. See Part 3 butterfly valve schedule articles.
5. Body Design: Single flange (lug type), suitable for bidirectional dead-end service at rated pressure without use of downstream flange.
6. Body Material: ASTM A126, cast iron or ASTM A536, ductile iron.
7. Seat: EPDM or NBR. See Part 3 butterfly valve schedule articles.
8. Stem: One- or two-piece stainless steel.
9. Disc: Nickel-plated or -coated ductile iron.

C. Butterfly Valves, Lead Free, Single Flange (Lug Type) - Iron, with Stainless Steel Disc:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Apollo Valves; a part of Aalberts Integrated Piping Systems
b. FNW; Ferguson Enterprises, Inc.
c. NIBCO INC.
d. WATTS; A Watts Water Technologies Company
e. Zurn Industries, LLC

2. Basis-of-Design Product: Subject to compliance with requirements, provide butterfly valve or comparable product by one of the following:

a. Apollo Valves; a part of Aalberts Integrated Piping Systems
b. FNW; Ferguson Enterprises, Inc.
c. NIBCO INC.
d. WATTS; A Watts Water Technologies Company
e. Zurn Industries, LLC

3. Standard: MSS SP-67, Type I.
4. CWP Rating, NPS 12 (DN 300) and Smaller: **150 psig** or **200 psig**. See Part 3 butterfly valve schedule articles.
5. Body Design: Single flange (lug type), suitable for bidirectional dead-end service at rated pressure without use of downstream flange.
6. Body Material: ASTM A126, cast iron or ASTM A536, ductile iron.
7. Seat: EPDM or NBR. See Part 3 butterfly valve schedule articles.
8. Stem: One- or two-piece stainless steel.

9. Disc: Stainless steel.

D. Butterfly Valves, Lead Free, Flangeless (Wafer Type) - Iron, with Aluminum-Bronze Disc:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

    a. Apollo Valves; a part of Aalberts Integrated Piping Systems
    b. FNW; Ferguson Enterprises, Inc.
    c. NIBCO INC.
    d. WATTS; A Watts Water Technologies Company
    e. Zurn Industries, LLC

2. Basis-of-Design Product: Subject to compliance with requirements, provide Insert manufacturer's name; product name or designation or comparable product by one of the following:

    a. Apollo Valves; a part of Aalberts Integrated Piping Systems
    b. FNW; Ferguson Enterprises, Inc.
    c. NIBCO INC.
    d. WATTS; A Watts Water Technologies Company
    e. Zurn Industries, LLC

3. Standard: MSS SP-67, Type I.
4. CWP Rating: **150 psig** or **200 psig**. See Part 3 butterfly valve schedule articles.
5. Body Design: Flangeless (wafer type), suitable for bidirectional dead-end service at rated pressure.
6. Body Material: ASTM A126, cast iron or ASTM A536, ductile iron.
7. Seat: EPDM or NBR. See Part 3 butterfly valve schedule articles.
8. Stem: One- or two-piece stainless steel.
9. Disc: Aluminum bronze.

E. Butterfly Valves, Lead Free, Flangeless (Wafer Type) - Iron, with Ductile-Iron Disc:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

    a. Apollo Valves; a part of Aalberts Integrated Piping Systems
    b. FNW; Ferguson Enterprises, Inc.
    c. NIBCO INC.
    d. WATTS; A Watts Water Technologies Company
    e. Zurn Industries, LLC

2. Basis-of-Design Product: Subject to compliance with requirements, provide Insert manufacturer's name; product name or designation or comparable product by one of the following:

    a. Apollo Valves; a part of Aalberts Integrated Piping Systems

b. FNW; Ferguson Enterprises, Inc.
c. NIBCO INC.
d. WATTS; A Watts Water Technologies Company
e. Zurn Industries, LLC

3. Standard: MSS SP-67, Type I.
4. CWP Rating: **150 psig** or **200 psig**. See Part 3 butterfly valve schedule articles.
5. Body Design: Flangeless (wafer type), suitable for bidirectional dead-end service at rated pressure.
6. Body Material: ASTM A126, cast iron or ASTM A536, ductile iron.
7. Seat: EPDM or NBR. See Part 3 butterfly valve schedule articles.
8. Stem: One- or two-piece stainless steel.
9. Disc: Nickel-plated or -coated ductile iron.

F. Butterfly Valves, Lead Free, Flangeless (Wafer Type) - Iron, with Stainless Steel Disc:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Apollo Valves; a part of Aalberts Integrated Piping Systems
b. FNW; Ferguson Enterprises, Inc.
c. NIBCO INC.
d. WATTS; A Watts Water Technologies Company
e. Zurn Industries, LLC

2. Basis-of-Design Product: Subject to compliance with requirements, provide Insert manufacturer's name; product name or designation or comparable product by one of the following:

a. Apollo Valves; a part of Aalberts Integrated Piping Systems
b. FNW; Ferguson Enterprises, Inc.
c. NIBCO INC.
d. WATTS; A Watts Water Technologies Company
e. Zurn Industries, LLC

3. Standard: MSS SP-67, Type I.
4. CWP Rating: **150 psig** or **200 psig**. See Part 3 butterfly valve schedule articles.
5. Body Design: Flangeless (wafer type), suitable for bidirectional dead-end service at rated pressure.
6. Body Material: ASTM A126, cast iron or ASTM A536, ductile iron.
7. Seat: EPDM or NBR. See Part 3 butterfly valve schedule articles.
8. Stem: One- or two-piece stainless steel.
9. Disc: Stainless steel.

G. Butterfly Valves, Lead Free, Grooved End - Ductile Iron, 175 CWP:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Apollo Valves; a part of Aalberts Integrated Piping Systems
b. NIBCO INC.
c. Tyco Fire Products; brand of Johnson Controls International plc, Building Solutions North America
d. Victaulic Company
e. Zurn Industries, LLC

2. Basis-of-Design Product: Subject to compliance with requirements, provide butterfly valve or comparable product by one of the following:

a. Apollo Valves; a part of Aalberts Integrated Piping Systems
b. NIBCO INC.
c. Tyco Fire Products; brand of Johnson Controls International plc, Building Solutions North America
d. Victaulic Company
e. Zurn Industries, LLC

3. Standard: MSS SP-67, Type I.
4. CWP Rating: **175 psig**.
5. Body Material: Coated, ductile iron.
6. Ends: Grooved.
7. Stem: Two-piece stainless steel.
8. Disc: Coated, ductile iron.
9. Seat: EPDM or NBR. See Part 3 butterfly valve schedule articles.

H. Butterfly Valves, Lead Free, Grooved End - Ductile Iron, 300 CWP:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Apollo Valves; a part of Aalberts Integrated Piping Systems
b. NIBCO INC.
c. Tyco Fire Products; brand of Johnson Controls International plc, Building Solutions North America
d. Victaulic Company
e. WATTS; A Watts Water Technologies Company

2. Basis-of-Design Product: Subject to compliance with requirements, provide butterfly valve or comparable product by one of the following:

a. Apollo Valves; a part of Aalberts Integrated Piping Systems
b. NIBCO INC.
c. Tyco Fire Products; brand of Johnson Controls International plc, Building Solutions North America
d. Victaulic Company
e. WATTS; A Watts Water Technologies Company

3. Standard: MSS SP-67, Type I.
4. CWP Rating, NPS 8 (DN 200) and Smaller: **300 psig**.
5. Body Material: Coated, ductile iron.

6. Ends: Grooved.
7. Stem: Two-piece stainless steel.
8. Disc: Coated, ductile iron.
9. Seat: EPDM or NBR. See Part 3 butterfly valve schedule articles.

I. Butterfly Valves, Lead Free, Grooved End - Stainless Steel:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

    a. Anvil; an ASC Engineered Solution
    b. Apollo Valves; a part of Aalberts Integrated Piping Systems
    c. Victaulic Company

2. Basis-of-Design Product: Subject to compliance with requirements, provide Insert manufacturer's name; product name or designation or comparable product by one of the following:

    a. Anvil; an ASC Engineered Solution
    b. Apollo Valves; a part of Aalberts Integrated Piping Systems
    c. Victaulic Company

3. Standard: MSS SP-67, Type I.
4. CWP Rating, NPS 8 (DN 200) and Smaller: **300 psig**.
5. CWP Rating, NPS 10 (DN 250) and Larger: **200 psig**.
6. Body Material: Type 316 stainless steel, ASTM A743/A743M.
7. Ends: Grooved.
8. Stem: Type 416 stainless steel.
9. Disc: Type 316 stainless steel or ductile iron, encapsulated with Grade "EN" EPDM.
10. Seat: EDPM.

J. Butterfly Valves - CPVC:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

    a. American Valve, Inc
    b. NIBCO INC.
    c. Spears Manufacturing Company

2. Basis-of-Design Product: Subject to compliance with requirements, provide butterfly valve or comparable product by one of the following:

    a. American Valve, Inc
    b. NIBCO INC.
    c. Spears Manufacturing Company

3. Pressure Rating and Temperature: **125 psig**, **150 psig**, or other pressure at

73 deg F or other temperature. See Part 3 butterfly valve schedule articles.
4. Body Material: CPVC.
5. Body Design: Flangeless (wafer) type.
6. Seat: EPDM rubber.
7. Seals: PTFE or EPDM-rubber O-rings.
8. Disc: CPVC.
9. Stem: Stainless steel.
10. Handle: Lever.

K. Butterfly Valves - PVC:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

   a. American Valve, Inc
   b. NIBCO INC.
   c. Spears Manufacturing Company
   d. Thermoplastic Valves, Inc

2. Basis-of-Design Product: Subject to compliance with requirements, provide butterfly valve or comparable product by one of the following:

   a. American Valve, Inc
   b. NIBCO INC.
   c. Spears Manufacturing Company
   d. Thermoplastic Valves, Inc

3. Pressure Rating and Temperature: **125 psig**, **150 psig**, or other pressure at **73 deg F** or other temperature. See Part 3 butterfly valve schedule articles.
4. Body Material: PVC.
5. Body Design: Flangeless (wafer) type.
6. Seat: EPDM rubber.
7. Seals: PTFE or EPDM-rubber O-rings.
8. Disc: PVC.
9. Stem: Stainless steel.
10. Handle: Lever.

2.5 BUTTERFLY VALVES, GENERAL PURPOSE

A. Butterfly Valves, Single Flange (Lug Type) - Iron, with Aluminum-Bronze Disc:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

   a. Apollo Valves; a part of Aalberts Integrated Piping Systems
   b. Center Line; a Crane Co. brand
   c. FNW; Ferguson Enterprises, Inc.
   d. NIBCO INC.

e. WATTS; A Watts Water Technologies Company
f. Zurn Industries, LLC

2. Basis-of-Design Product: Subject to compliance with requirements, provide Insert manufacturer's name; product name or designation or comparable product by one of the following:

a. Apollo Valves; a part of Aalberts Integrated Piping Systems
b. Center Line; a Crane Co. brand
c. FNW; Ferguson Enterprises, Inc.
d. NIBCO INC.
e. WATTS; A Watts Water Technologies Company
f. Zurn Industries, LLC

3. Standard: MSS SP-67, Type I.
4. CWP Rating: **150 psig** or **200 psig**. See Part 3 butterfly valve schedule articles.
5. Body Design: Single flange (lug type), suitable for bidirectional dead-end service at rated pressure without use of downstream flange.
6. Body Material: ASTM A126, cast iron or ASTM A536, ductile iron.
7. Seat: NBR.
8. Stem: One- or two-piece stainless steel.
9. Disc: Aluminum bronze.

B. Butterfly Valves, Single Flange (Lug Type) - Iron, with Ductile-Iron Disc:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Apollo Valves; a part of Aalberts Integrated Piping Systems
b. FNW; Ferguson Enterprises, Inc.
c. NIBCO INC.
d. WATTS; A Watts Water Technologies Company
e. Zurn Industries, LLC

2. Basis-of-Design Product: Subject to compliance with requirements, provide Insert manufacturer's name; product name or designation or comparable product by one of the following:

a. Apollo Valves; a part of Aalberts Integrated Piping Systems
b. FNW; Ferguson Enterprises, Inc.
c. NIBCO INC.
d. WATTS; A Watts Water Technologies Company
e. Zurn Industries, LLC

3. Standard: MSS SP-67, Type I.
4. CWP Rating: **150 psig** or **200 psig**. See Part 3 butterfly valve schedule articles.
5. Body Design: Single flange (lug type), suitable for bidirectional dead-end service at rated pressure without use of downstream flange.
6. Body Material: ASTM A126, cast iron or ASTM A536, ductile iron.
7. Seat: NBR.

8. Stem: One- or two-piece stainless steel.
9. Disc: Nickel-plated or -coated ductile iron.

C. Butterfly Valves, Single Flange (Lug Type) - Iron, with Stainless Steel Disc:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

    a. Apollo Valves; a part of Aalberts Integrated Piping Systems
    b. FNW; Ferguson Enterprises, Inc.
    c. NIBCO INC.
    d. WATTS; A Watts Water Technologies Company
    e. Zurn Industries, LLC

2. Basis-of-Design Product: Subject to compliance with requirements, provide butterfly valve or comparable product by one of the following:

    a. Apollo Valves; a part of Aalberts Integrated Piping Systems
    b. FNW; Ferguson Enterprises, Inc.
    c. NIBCO INC.
    d. WATTS; A Watts Water Technologies Company
    e. Zurn Industries, LLC

3. Standard: MSS SP-67, Type I.
4. CWP Rating: **150 psig** or **200 psig**. See Part 3 butterfly valve schedule articles.
5. Body Design: Single flange (lug type), suitable for bidirectional dead-end service at rated pressure without use of downstream flange.
6. Body Material: ASTM A126, cast iron or ASTM A536, ductile iron.
7. Seat: NBR.
8. Stem: One- or two-piece stainless steel.
9. Disc: Stainless steel.

D. Butterfly Valves, Flangeless (Wafer Type) - Iron, with Aluminum-Bronze Disc:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

    a. Apollo Valves; a part of Aalberts Integrated Piping Systems
    b. FNW; Ferguson Enterprises, Inc.
    c. NIBCO INC.
    d. WATTS; A Watts Water Technologies Company
    e. Zurn Industries, LLC

2. Basis-of-Design Product: Subject to compliance with requirements, provide Insert manufacturer's name; product name or designation or comparable product by one of the following:

    a. Apollo Valves; a part of Aalberts Integrated Piping Systems
    b. FNW; Ferguson Enterprises, Inc.

c. NIBCO INC.
d. WATTS; A Watts Water Technologies Company
e. Zurn Industries, LLC

3. Standard: MSS SP-67, Type I.
4. CWP Rating: **150 psig** or **200 psig**. See Part 3 butterfly valve schedule articles.
5. Body Design: Flangeless (wafer type), suitable for bidirectional dead-end service at rated pressure.
6. Body Material: ASTM A126, cast iron or ASTM A536, ductile iron.
7. Seat: NBR.
8. Stem: One- or two-piece stainless steel.
9. Disc: Aluminum bronze.

E. Butterfly Valves, Flangeless (Wafer Type) - Iron, with Ductile-Iron Disc:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Apollo Valves; a part of Aalberts Integrated Piping Systems
b. FNW; Ferguson Enterprises, Inc.
c. NIBCO INC.
d. WATTS; A Watts Water Technologies Company
e. Zurn Industries, LLC

2. Basis-of-Design Product: Subject to compliance with requirements, provide butterfly valve or comparable product by one of the following:

a. Apollo Valves; a part of Aalberts Integrated Piping Systems
b. FNW; Ferguson Enterprises, Inc.
c. NIBCO INC.
d. WATTS; A Watts Water Technologies Company
e. Zurn Industries, LLC

3. Standard: MSS SP-67, Type I.
4. CWP Rating: **150 psig** or **200 psig**. See Part 3 butterfly valve schedule articles.
5. Body Design: Flangeless (wafer type), suitable for bidirectional dead-end service at rated pressure.
6. Body Material: ASTM A126, cast iron or ASTM A536, ductile iron.
7. Seat: NBR.
8. Stem: One- or two-piece stainless steel.
9. Disc: Nickel-plated or -coated ductile iron.

F. Butterfly Valves, Flangeless (Wafer Type) - Iron, with Stainless Steel Disc:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Apollo Valves; a part of Aalberts Integrated Piping Systems
b. FNW; Ferguson Enterprises, Inc.

c. NIBCO INC.
d. WATTS; A Watts Water Technologies Company
e. Zurn Industries, LLC

2. Basis-of-Design Product: Subject to compliance with requirements, provide butterfly valve or comparable product by one of the following:

a. Apollo Valves; a part of Aalberts Integrated Piping Systems
b. FNW; Ferguson Enterprises, Inc.
c. NIBCO INC.
d. WATTS; A Watts Water Technologies Company
e. Zurn Industries, LLC

3. Standard: MSS SP-67, Type I.
4. CWP Rating: **150 psig** or **200 psig**. See Part 3 butterfly valve schedule articles.
5. Body Design: Flangeless (wafer type), suitable for bidirectional dead-end service at rated pressure.
6. Body Material: ASTM A126, cast iron or ASTM A536, ductile iron.
7. Seat: NBR.
8. Stem: One- or two-piece stainless steel.
9. Disc: Stainless steel.

G. Butterfly Valves, Grooved End - Ductile Iron, 175 CWP:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Apollo Valves; a part of Aalberts Integrated Piping Systems
b. NIBCO INC.
c. Tyco Fire Products; brand of Johnson Controls International plc, Building Solutions North America
d. Victaulic Company
e. Zurn Industries, LLC

2. Basis-of-Design Product: Subject to compliance with requirements, provide Insert manufacturer's name; product name or designation or comparable product by one of the following:

a. Apollo Valves; a part of Aalberts Integrated Piping Systems
b. NIBCO INC.
c. Tyco Fire Products; brand of Johnson Controls International plc, Building Solutions North America
d. Victaulic Company
e. Zurn Industries, LLC

3. Standard: MSS SP-67, Type I.
4. CWP Rating: **175 psig**.
5. Body Material: Coated, ductile iron.
6. Ends: Grooved.
7. Stem: Two-piece stainless steel.

8. Disc: Coated, ductile iron.
9. Seat: NBR.

H. Butterfly Valves, Grooved End - Ductile Iron, 300 CWP:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

   a. Anvil; an ASC Engineered Solution
   b. Grinnell G-Fire; brand of Johnson Controls International plc, Building Solutions North America
   c. NIBCO INC.
   d. Tyco Fire Products; brand of Johnson Controls International plc, Building Solutions North America
   e. Victaulic Company
   f. WATTS; A Watts Water Technologies Company

2. Basis-of-Design Product: Subject to compliance with requirements, provide butterfly valve or comparable product by one of the following:

   a. Anvil; an ASC Engineered Solution
   b. Grinnell G-Fire; brand of Johnson Controls International plc, Building Solutions North America
   c. NIBCO INC.
   d. Tyco Fire Products; brand of Johnson Controls International plc, Building Solutions North America
   e. Victaulic Company
   f. WATTS; A Watts Water Technologies Company

3. Standard: MSS SP-67, Type I.
4. CWP Rating, NPS 8 (DN 200) and Smaller: **300 psig**.
5. Body Material: Coated, ductile iron
6. Ends: Grooved.
7. Stem: Two-piece stainless steel.
8. Disc: Coated, ductile iron.
9. Seat: NBR.

I. Butterfly Valves, Grooved End - Stainless Steel:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

   a. Apollo Valves; a part of Aalberts Integrated Piping Systems
   b. Victaulic Company

2. Basis-of-Design Product: Subject to compliance with requirements, provide butterfly valve or comparable product by one of the following:

   a. Apollo Valves; a part of Aalberts Integrated Piping Systems

b. Victaulic Company

3. Standard: MSS SP-67, Type I.
4. CWP Rating, NPS 8 (DN 200) and Smaller: **300 psig**.
5. Body Material: Type 316 stainless steel, ASTM A743/A743M.
6. Ends: Grooved.
7. Stem: Type 416 stainless steel.
8. Disc: Type 316 stainless steel.
9. Seat: NBR.

2.6 CHECK VALVES, LEAD FREE

A. Check Valves, Lead Free, Swing Type, Threaded or Soldered Ends - Bronze, with Bronze Disc, Class 125:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

   a. Apollo Valves; a part of Aalberts Integrated Piping Systems
   b. NIBCO INC.
   c. Victaulic Company

2. Basis-of-Design Product: Subject to compliance with requirements, provide check valve or comparable product by one of the following:

   a. Apollo Valves; a part of Aalberts Integrated Piping Systems
   b. NIBCO INC.
   c. Victaulic Company

3. Standard: MSS SP-80, Type 3.
4. CWP Rating: **200 psig**.
5. Body Design: Horizontal flow.
6. Body Material: ASTM B62, bronze.
7. Ends: Threaded or soldered. See Part 3 check valve schedule articles.
8. Disc: Bronze.

B. Check Valves, Lead Free, Swing Type, Threaded or Soldered Ends - Bronze, with Nonmetallic Disc, Class 125:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

   a. Apollo Valves; a part of Aalberts Integrated Piping Systems
   b. Crane Fluid Systems; Crane Co.
   c. NIBCO INC.

2. Basis-of-Design Product: Subject to compliance with requirements, provide check valve or comparable product by one of the following:

a. Apollo Valves; a part of Aalberts Integrated Piping Systems
b. Crane Fluid Systems; Crane Co.
c. NIBCO INC.

3. Standard: MSS SP-80, Type 4.
4. CWP Rating: **200 psig**.
5. Body Design: Horizontal flow.
6. Body Material: ASTM B62, bronze.
7. Ends: Threaded or soldered. See Part 3 check valve schedule articles.
8. Disc: PTFE.

C. Check Valves, Lead Free, Swing Type, Threaded or Soldered Ends - Bronze, with Bronze Disc, Class 150:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Apollo Valves; a part of Aalberts Integrated Piping Systems
b. Crane Fluid Systems; Crane Co.
c. NIBCO INC.

2. Basis-of-Design Product: Subject to compliance with requirements, provide check valve or comparable product by one of the following:

a. Apollo Valves; a part of Aalberts Integrated Piping Systems
b. Crane Fluid Systems; Crane Co.
c. NIBCO INC.

3. Standard: MSS SP-80, Type 3.
4. CWP Rating: **300 psig**.
5. Body Design: Horizontal flow.
6. Body Material: ASTM B62, bronze.
7. Ends: Threaded or soldered. See Part 3 check valve schedule articles.
8. Disc: Bronze.

D. Check Valves, Lead Free, Swing Type, Threaded or Soldered Ends - Bronze, with Nonmetallic Disc, Class 150:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Crane Fluid Systems; Crane Co.
b. FNW; Ferguson Enterprises, Inc.
c. NIBCO INC.

2. Basis-of-Design Product: Subject to compliance with requirements, provide check valve or comparable product by one of the following:

a. Crane Fluid Systems; Crane Co.

b. FNW; Ferguson Enterprises, Inc.
c. NIBCO INC.

3. Standard: MSS SP-80, Type 4.
4. CWP Rating: **300 psig**.
5. Body Design: Horizontal flow.
6. Body Material: ASTM B62, bronze.
7. Ends: Threaded or soldered. See Part 3 check valve schedule articles.
8. Disc: PTFE.

E. Check Valves, Lead Free, Swing Type, Press Ends - Bronze:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Apollo Valves; a part of Aalberts Integrated Piping Systems
b. Crane Fluid Systems; Crane Co.
c. NIBCO INC.

2. Basis-of-Design Product: Subject to compliance with requirements, provide Insert manufacturer's name; product name or designation or comparable product by one of the following:

a. Apollo Valves; a part of Aalberts Integrated Piping Systems
b. Crane Fluid Systems; Crane Co.
c. NIBCO INC.

3. Standards: MSS SP-80 and MSS SP-139.
4. CWP Rating: Minimum **200 psig**.
5. Body Design: Horizontal flow.
6. Body Material: ASTM B584, bronze.
7. Ends: Press.
8. Press-End Connections Rating: Minimum **200 psig**.
9. Disc: Brass or bronze.

F. Check Valves, Lead Free, Swing Type, Flanged or Threaded Ends - Iron, with Metal Seats, Class 125:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Apollo Valves; a part of Aalberts Integrated Piping Systems
b. Crane Fluid Systems; Crane Co.
c. Victaulic Company

2. Basis-of-Design Product: Subject to compliance with requirements, provide Insert manufacturer's name; product name or designation or comparable product by one of the following:

a. Apollo Valves; a part of Aalberts Integrated Piping Systems
b. Crane Fluid Systems; Crane Co.
c. Victaulic Company

3. Standard: MSS SP-71, Type I.
4. CWP Rating: **200 psig**.
5. Body Design: Clear or full waterway.
6. Body Material: ASTM A126, gray iron with bolted bonnet.
7. Ends: Flanged or threaded. See Part 3 check valve schedule articles.
8. Trim: Bronze.
9. Gasket: Asbestos free.

G. Check Valves, Lead Free, Swing Type, Flanged or Threaded Ends - Iron, with Nonmetallic-to-Metal Seats, Class 125:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Crane Fluid Systems; Crane Co.
b. Tyco Fire Products; brand of Johnson Controls International plc, Building Solutions North America
c. Victaulic Company

2. Basis-of-Design Product: Subject to compliance with requirements, provide check valve or comparable product by one of the following:

a. Crane Fluid Systems; Crane Co.
b. Tyco Fire Products; brand of Johnson Controls International plc, Building Solutions North America
c. Victaulic Company

3. Standard: MSS SP-71, Type I.
4. CWP Rating: **200 psig**.
5. Body Design: Clear or full waterway.
6. Body Material: ASTM A126, gray iron with bolted bonnet.
7. Ends: Flanged or threaded. See Part 3 check valve schedule articles.
8. Trim: Composition.
9. Seat Ring: Bronze.
10. Disc Holder: Bronze.
11. Disc: PTFE.
12. Gasket: Asbestos free.

H. Check Valves, Lead Free, Swing Type, Flanged or Threaded Ends - Iron, with Metal Seats, Class 250:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Apollo Valves; a part of Aalberts Integrated Piping Systems

b. Crane Fluid Systems; Crane Co.
c. Victaulic Company

2. Basis-of-Design Product: Subject to compliance with requirements, provide check valve or comparable product by one of the following:

a. Apollo Valves; a part of Aalberts Integrated Piping Systems
b. Crane Fluid Systems; Crane Co.
c. Victaulic Company

3. Standard: MSS SP-71, Type I.
4. CWP Rating: **500 psig**.
5. Body Design: Clear or full waterway.
6. Body Material: ASTM A126, gray iron with bolted bonnet.
7. Ends: Flanged or threaded. See Part 3 check valve schedule articles.
8. Trim: Bronze.
9. Gasket: Asbestos free.

I. Check Valves, Lead Free, Swing Type, Flanged or Threaded Ends - Iron, with Lever- and Spring-Closure Control, Class 125:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Apollo Valves; a part of Aalberts Integrated Piping Systems

2. Basis-of-Design Product: Subject to compliance with requirements, provide check valve or comparable product by one of the following:

a. Apollo Valves; a part of Aalberts Integrated Piping Systems

3. Standard: MSS SP-71, Type I.
4. CWP Rating: **200 psig**.
5. Body Design: Clear or full waterway.
6. Body Material: ASTM A126, gray iron with bolted bonnet.
7. Ends: Flanged or threaded. See Part 3 check valve schedule articles.
8. Trim: Bronze.
9. Gasket: Asbestos free.
10. Closure Control: Factory-installed exterior lever and weight.

J. Check Valves, Lead Free, Swing Type, Flanged or Threaded Ends - Iron, with Lever- and Weight-Closure Control, Class 125:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Apollo Valves; a part of Aalberts Integrated Piping Systems
b. ASC Engineered Solutions
c. Clow Valve Company; a subsidiary of McWane, Inc.

d. Cooper Valves
e. Crispin Valve
f. DeZURIK
g. GA Industries, Inc
h. Kennedy Valve Company; a division of McWane, Inc.
i. Milwaukee Valve Company

2. Basis-of-Design Product: Subject to compliance with requirements, provide check valve or comparable product by one of the following:

a. Apollo Valves; a part of Aalberts Integrated Piping Systems
b. ASC Engineered Solutions
c. Clow Valve Company; a subsidiary of McWane, Inc.
d. Cooper Valves
e. Crispin Valve
f. DeZURIK
g. GA Industries, Inc
h. Kennedy Valve Company; a division of McWane, Inc.
i. Milwaukee Valve Company

3. Standard: MSS SP-71, Type I.
4. CWP Rating: **200 psig**.
5. Body Design: Clear or full waterway.
6. Body Material: ASTM A126, gray iron with bolted bonnet.
7. Ends: Flanged or threaded. See Part 3 check valve schedule articles.
8. Trim: Bronze.
9. Gasket: Asbestos free.
10. Closure Control: Factory-installed exterior lever and weight.

K. Check Valves, Lead Free, Swing Type, Grooved Ends - Iron, 300 CWP:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Tyco Fire Products; brand of Johnson Controls International plc, Building Solutions North America
b. Victaulic Company

2. Basis-of-Design Product: Subject to compliance with requirements, provide check valve or comparable product by one of the following:

a. Tyco Fire Products; brand of Johnson Controls International plc, Building Solutions North America
b. Victaulic Company

3. CWP Rating: **300 psig**.
4. Body Material: ASTM A536, ductile iron.
5. Seat: EPDM.
6. Disc: Spring operated, ductile iron or stainless steel.

L. Check Valves, Lead Free, Center Guided - Iron, Compact Wafer, with Metal Seat, Class 125:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

   a. Apollo Valves; a part of Aalberts Integrated Piping Systems
   b. Victaulic Company

2. Basis-of-Design Product: Subject to compliance with requirements, provide check valve or comparable product by one of the following:

   a. Apollo Valves; a part of Aalberts Integrated Piping Systems
   b. Victaulic Company

3. Standard: MSS SP-125.
4. CWP Rating: **200 psig**.
5. Body Material: ASTM A126, gray iron.
6. Style: Compact wafer, spring loaded.
7. Seat: Bronze.

M. Check Valves, Lead Free, Center Guided - Iron, Globe, with Metal Seat, Class 125:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

   a. Mueller Steam Specialty; A Watts Water Technologies Company
   b. WATTS; A Watts Water Technologies Company

2. Basis-of-Design Product: Subject to compliance with requirements, provide check valve or comparable product by one of the following:

   a. Mueller Steam Specialty; A Watts Water Technologies Company
   b. WATTS; A Watts Water Technologies Company

3. Standard: MSS SP-125.
4. CWP Rating: **200 psig**.
5. Body Material: ASTM A126, gray iron.
6. Style: Globe, spring loaded.
7. Ends: Flange.
8. Seat: Bronze.

N. Check Valves, Lead Free, Center Guided - Iron, Compact Wafer, with Metal Seat, Class 150:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Apollo Valves; a part of Aalberts Integrated Piping Systems
b. Mueller Steam Specialty; A Watts Water Technologies Company
c. Victaulic Company

2. Basis-of-Design Product: Subject to compliance with requirements, provide check valve or comparable product by one of the following:

a. Apollo Valves; a part of Aalberts Integrated Piping Systems
b. Mueller Steam Specialty; A Watts Water Technologies Company
c. Victaulic Company

3. Standard: MSS SP-125.
4. CWP Rating: **300 psig**.
5. Body Material: ASTM A395/A395M or ASTM A536, ductile iron.
6. Style: Compact wafer, spring loaded.
7. Seat: Bronze.

O. Check Valves, Lead Free, Center Guided - Iron, Globe, with Metal Seat, Class 150:

1. Manufacturers: Subject to compliance with requirements, provide products by the following:

a. Mueller Steam Specialty; A Watts Water Technologies Company

2. Basis-of-Design Product: Subject to compliance with requirements, provide check valve or comparable product by one of the following:

a. Mueller Steam Specialty; A Watts Water Technologies Company

3. Standard: MSS SP-125.
4. CWP Rating: **300 psig**.
5. Body Material: ASTM A395/A395M or ASTM A536, ductile iron.
6. Style: Globe, spring loaded.
7. Ends: Flange.
8. Seat: Bronze.

P. Check Valves, Lead Free, Center Guided - Iron, Compact Wafer, with Metal Seat, Class 250:

1. Manufacturers: Subject to compliance with requirements, provide products by the following:

a. Mueller Steam Specialty; A Watts Water Technologies Company
b. Victaulic Company

2. Basis-of-Design Product: Subject to compliance with requirements, provide check valve or comparable product by one of the following:

a. Mueller Steam Specialty; A Watts Water Technologies Company
b. Victaulic Company

3. Standard: MSS SP-125.
4. CWP Rating: **400 psig**.
5. Body Material: ASTM A126, gray iron.
6. Style: Compact wafer, spring loaded.
7. Seat: Bronze.

Q. Check Valves, Lead Free, Center Guided - Iron, Globe, with Metal Seat, Class 250:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

   a. Mueller Steam Specialty; A Watts Water Technologies Company
   b. Val-Matic Valve & Manufacturing Corp.

2. Basis-of-Design Product: Subject to compliance with requirements, provide check valve or comparable product by one of the following:

   a. Mueller Steam Specialty; A Watts Water Technologies Company
   b. Val-Matic Valve & Manufacturing Corp.

3. Standard: MSS SP-125.
4. CWP Rating: **400 psig**.
5. Body Material: ASTM A126, gray iron.
6. Style: Globe, spring loaded.
7. Ends: Flange.
8. Seat: Bronze.

R. Check Valves, Lead Free, Center Guided - Iron, Compact Wafer, with Metal Seat, Class 300:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

   a. Mueller Steam Specialty; A Watts Water Technologies Company
   b. Victaulic Company

2. Basis-of-Design Product: Subject to compliance with requirements, provide check valve or comparable product by one of the following:

   a. Mueller Steam Specialty; A Watts Water Technologies Company
   b. Victaulic Company

3. Standard: MSS SP-125.
4. CWP Rating: **500 psig**.
5. Body Material: ASTM A395/A395M or ASTM A536, ductile iron.
6. Style: Compact wafer, spring loaded.
7. Seat: Bronze.

S. Check Valves, Lead Free, Center Guided - Iron, Globe, with Metal Seat, Class 300:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

    a. Metraflex Company (The)

2. Basis-of-Design Product: Subject to compliance with requirements, provide check valve or comparable product by one of the following:

    a. Metraflex Company (The)

3. Standard: MSS SP-125.
4. CWP Rating: **500 psig**.
5. Body Material: ASTM A395/A395M or ASTM A536, ductile iron.
6. Style: Globe, spring loaded.
7. Ends: Flange.
8. Seat: Bronze.

T. Check Valves, Lead Free, Center Guided - Iron, Compact Wafer, with Resilient Seat, Class 125:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

    a. Apollo Valves; a part of Aalberts Integrated Piping Systems
    b. Victaulic Company

2. Basis-of-Design Product: Subject to compliance with requirements, provide check valve or comparable product by one of the following:

    a. Apollo Valves; a part of Aalberts Integrated Piping Systems
    b. Victaulic Company

3. Standard: MSS SP-125.
4. CWP Rating: **200 psig**.
5. Body Material: ASTM A126, gray iron.
6. Style: Compact wafer, spring loaded.
7. Seat: EPDM or NBR. See Part 3 check valve schedule articles.

U. Check Valves, Lead Free, Center Guided - Iron, Globe, with Resilient Seat, Class 125:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

    a. DFT Inc.
    b. Flomatic Valves; Flomatic Corporation
    c. Val-Matic Valve & Manufacturing Corp.

2. Basis-of-Design Product: Subject to compliance with requirements, provide

check valve or comparable product by one of the following:

a. DFT Inc.
b. Flomatic Valves; Flomatic Corporation
c. Val-Matic Valve & Manufacturing Corp.

3. Standard: MSS SP-125.
4. CWP Rating: **200 psig**.
5. Body Material: ASTM A126, gray iron.
6. Style: Globe, spring loaded.
7. Ends: Flange.
8. Seat: EPDM or NBR. See Part 3 check valve schedule articles.

V. Check Valves, Lead Free, Center Guided - Iron, Compact Wafer, with Resilient Seat, Class 150:

1. Manufacturers: Subject to compliance with requirements, provide products by the following:

a. Victaulic Company

2. Basis-of-Design Product: Subject to compliance with requirements, provide check valve or comparable product by one of the following:

a. Victaulic Company

3. Standard: MSS SP-125.
4. CWP Rating: **300 psig**.
5. Body Material: ASTM A395/A395M or ASTM A536, ductile iron.
6. Style: Compact wafer, spring loaded.
7. Seat: EPDM or NBR. See Part 3 check valve schedule articles.

W. Check Valves, Lead Free, Center Guided - Iron, Globe, with Resilient Seat, Class 150:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. DFT Inc.
b. Flomatic Valves; Flomatic Corporation
c. Val-Matic Valve & Manufacturing Corp.

2. Basis-of-Design Product: Subject to compliance with requirements, provide check valve or comparable product by one of the following:

a. DFT Inc.
b. Flomatic Valves; Flomatic Corporation
c. Val-Matic Valve & Manufacturing Corp.

3. Standard: MSS SP-125.
4. CWP Rating: **300 psig**.

5. Body Material: ASTM A395/A395M or ASTM A536, ductile iron.
6. Style: Globe, spring loaded.
7. Ends: Flange.
8. Seat: EPDM or NBR. See Part 3 check valve schedule articles.

X. Check Valves, Lead Free, Center Guided - Iron, Compact Wafer, with Resilient Seat, Class 250:

1. Manufacturers: Subject to compliance with requirements, provide products by the following:

    a. Victaulic Company

2. Basis-of-Design Product: Subject to compliance with requirements, provide check valve or comparable product by one of the following:

    a. Victaulic Company

3. Standard: MSS SP-125.
4. CWP Rating: **400 psig**.
5. Body Material: ASTM A126, gray iron.
6. Style: Compact wafer, spring loaded.
7. Seat: EPDM or NBR. See Part 3 check valve schedule articles.

Y. Check Valves, Lead Free, Center Guided - Iron, Globe, with Resilient Seat, Class 250:

1. Manufacturers: Subject to compliance with requirements, provide products by the following:

    a. DFT Inc.
    b. Flomatic Valves; Flomatic Corporation
    c. Val-Matic Valve & Manufacturing Corp.

2. Basis-of-Design Product: Subject to compliance with requirements, provide check valve or comparable product by one of the following:

    a. DFT Inc.
    b. Flomatic Valves; Flomatic Corporation
    c. Val-Matic Valve & Manufacturing Corp.

3. Standard: MSS SP-125.
4. CWP Rating: **400 psig**.
5. Body Material: ASTM A126, gray iron.
6. Style: Globe, spring loaded.
7. Ends: Flange.
8. Seat: EPDM or NBR. See Part 3 check valve schedule articles.

Z. Check Valves, Lead Free, Center Guided - Iron, Compact Wafer, with Resilient Seat, Class 300:

1. Manufacturers: Subject to compliance with requirements, available

manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Victaulic Company

2. Basis-of-Design Product: Subject to compliance with requirements, provide check valve or comparable product by one of the following:

a. Victaulic Company

3. Standard: MSS SP-125.
4. CWP Rating: **500 psig**.
5. Body Material: ASTM A395/A395M or ASTM A536, ductile iron.
6. Style: Compact wafer, spring loaded.
7. Seat: EPDM or NBR. See Part 3 check valve schedule articles.

AA. Check Valves, Lead Free, Center Guided - Iron, Globe, with Resilient Seat, Class 300:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. DFT Inc.
b. Flomatic Valves; Flomatic Corporation
c. Shurjoint; a part of Aalberts Integrated Piping Systems

2. Basis-of-Design Product: Subject to compliance with requirements, provide check valve or comparable product by one of the following:

a. DFT Inc.
b. Flomatic Valves; Flomatic Corporation
c. Shurjoint; a part of Aalberts Integrated Piping Systems

3. Standard: MSS SP-125.
4. CWP Rating: **500 psig**.
5. Body Material: ASTM A395/A395M or ASTM A536, ductile iron.
6. Style: Globe, spring loaded.
7. Ends: Flange.
8. Seat: EPDM or NBR. See Part 3 check valve schedule articles.

BB. Check Valves, Lead Free, Dual-Plate Type - Iron, with Metal Seat, Class 125:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. ABZ Valve; an ASC Engineered Solution
b. Anvil; an ASC Engineered Solution
c. DeZURIK
d. Flo Fab Inc
e. Flomatic Valves; Flomatic Corporation

f. Jomar Valve
g. Keckley Company
h. Lance Valves
i. Metraflex Company (The)
j. Shurjoint; a part of Aalberts Integrated Piping Systems
k. Stockham; a Crane Co. brand
l. Sure Flow Equipment Inc

2. Basis-of-Design Product: Subject to compliance with requirements, provide check valve or comparable product by one of the following:

a. ABZ Valve; an ASC Engineered Solution
b. Anvil; an ASC Engineered Solution
c. DeZURIK
d. Flo Fab Inc
e. Flomatic Valves; Flomatic Corporation
f. Jomar Valve
g. Keckley Company
h. Lance Valves
i. Metraflex Company (The)
j. Shurjoint; a part of Aalberts Integrated Piping Systems
k. Stockham; a Crane Co. brand
l. Sure Flow Equipment Inc

3. Standard: API 594.
4. CWP Rating: **200 psig**.
5. Body Design: Wafer, spring-loaded plates.
6. Body Material: ASTM A126, gray iron.
7. Seat: Bronze.

CC. Check Valves, Lead Free, Dual-Plate Type - Iron, with Metal Seat, Class 150:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Mueller Steam Specialty; A Watts Water Technologies Company

2. Basis-of-Design Product: Subject to compliance with requirements, provide check valve or comparable product by one of the following:

a. Mueller Steam Specialty; A Watts Water Technologies Company

3. Standard: API 594.
4. CWP Rating: **300 psig**.
5. Body Design: Wafer, spring-loaded plates.
6. Body Material: ASTM A395/A395M or ASTM A536, ductile iron.
7. Seat: Bronze.

DD. Check Valves, Lead Free, Dual-Plate Type - Iron, with Metal Seat, Class 250:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

    a. ABZ Valve; an ASC Engineered Solution
    b. Anvil; an ASC Engineered Solution
    c. Keckley Company
    d. Stockham; a Crane Co. brand
    e. Sure Flow Equipment Inc
    f. Val-Matic Valve & Manufacturing Corp.

2. Basis-of-Design Product: Subject to compliance with requirements, provide check valve or comparable product by one of the following:

    a. ABZ Valve; an ASC Engineered Solution
    b. Anvil; an ASC Engineered Solution
    c. Keckley Company
    d. Stockham; a Crane Co. brand
    e. Sure Flow Equipment Inc
    f. Val-Matic Valve & Manufacturing Corp.

3. Standard: API 594.
4. CWP Rating: **400 psig**.
5. Body Design: Wafer, spring-loaded plates.
6. Body Material: ASTM A126, gray iron.
7. Seat: Bronze.

EE. Check Valves, Lead Free, Dual-Plate Type - Iron, with Metal Seat, Class 300:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

    a. ABZ Valve; an ASC Engineered Solution
    b. Anvil; an ASC Engineered Solution
    c. Keckley Company
    d. Shurjoint; a part of Aalberts Integrated Piping Systems
    e. Sure Flow Equipment Inc

2. Basis-of-Design Product: Subject to compliance with requirements, provide check valve or comparable product by one of the following:

    a. ABZ Valve; an ASC Engineered Solution
    b. Anvil; an ASC Engineered Solution
    c. Keckley Company
    d. Shurjoint; a part of Aalberts Integrated Piping Systems
    e. Sure Flow Equipment Inc

3. Standard: API 594.
4. CWP Rating: **500 psig**.
5. Body Design: Wafer, spring-loaded plates.

6. Body Material: ASTM A395/A395M or ASTM A536, ductile iron.
7. Seat: Bronze.

FF. Check Valves, Lead Free, Single-Plate Type - Iron, with Resilient Seat, Class 125:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

    a. Flowserve Corporation
    b. GA Industries, Inc
    c. Jomar Valve
    d. Keckley Company

2. Basis-of-Design Product: Subject to compliance with requirements, provide check valve or comparable product by one of the following:

    a. Flowserve Corporation
    b. GA Industries, Inc
    c. Jomar Valve
    d. Keckley Company

3. Standard: API 594.
4. CWP Rating: **200 psig**.
5. Body Design: Wafer, single spring-loaded plate.
6. Body Material: ASTM A126, gray iron.
7. Seat: EPDM or NBR. See Part 3 check valve schedule articles.

GG. Check Valves, Lead Free, Dual-Plate Type - Iron, with Resilient Seat, Class 125:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

    a. Flomatic Valves; Flomatic Corporation
    b. Keckley Company
    c. Stockham; a Crane Co. brand
    d. Sure Flow Equipment Inc

2. Basis-of-Design Product: Subject to compliance with requirements, provide check valve or comparable product by one of the following:

    a. Flomatic Valves; Flomatic Corporation
    b. Keckley Company
    c. Stockham; a Crane Co. brand
    d. Sure Flow Equipment Inc

3. Standard: API 594.
4. CWP Rating: **200 psig**.
5. Body Design: Wafer, spring-loaded plates.
6. Body Material: ASTM A126, gray iron.

7. Seat: EPDM or NBR. See Part 3 check valve schedule articles.

HH. Check Valves, Lead Free, Dual-Plate Type - Iron, with Resilient Seat, Class 150:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

    a. DeZURIK
    b. Keckley Company
    c. Stockham; a Crane Co. brand
    d. Sure Flow Equipment Inc

2. Basis-of-Design Product: Subject to compliance with requirements, provide check valve or comparable product by one of the following:

    a. DeZURIK
    b. Keckley Company
    c. Stockham; a Crane Co. brand
    d. Sure Flow Equipment Inc

3. Standard: API 594.
4. CWP Rating: **300 psig**.
5. Body Design: Wafer, spring-loaded plates.
6. Body Material: ASTM A395/A395M or ASTM A536, ductile iron.
7. Seat: EPDM or NBR. See Part 3 check valve schedule articles.

II. Check Valves, Lead Free, Single-Plate Type - Iron, with Resilient Seat, Class 250:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

    a. Flowserve Corporation
    b. GA Industries, Inc
    c. Jomar Valve
    d. Keckley Company
    e. Victaulic Company

2. Basis-of-Design Product: Subject to compliance with requirements, provide check valve or comparable product by one of the following:

    a. Flowserve Corporation
    b. GA Industries, Inc
    c. Jomar Valve
    d. Keckley Company
    e. Victaulic Company

3. Standard: API 594.
4. CWP Rating: **400 psig**.
5. Body Design: Wafer, single spring-loaded plate.

6. Body Material: ASTM A126, gray iron.
7. Seat: EPDM or NBR. See Part 3 check valve schedule articles.

JJ. Check Valves, Lead Free, Dual-Plate Type - Iron, with Resilient Seat, Class 250:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

    a. Jomar Valve
    b. Keckley Company
    c. Stockham; a Crane Co. brand
    d. Sure Flow Equipment Inc
    e. Val-Matic Valve & Manufacturing Corp.

2. Basis-of-Design Product: Subject to compliance with requirements, provide check valve or comparable product by one of the following:

    a. Jomar Valve
    b. Keckley Company
    c. Stockham; a Crane Co. brand
    d. Sure Flow Equipment Inc
    e. Val-Matic Valve & Manufacturing Corp.

3. Standard: API 594.
4. CWP Rating: **400 psig**.
5. Body Design: Wafer, spring-loaded plates.
6. Body Material: ASTM A126, gray iron.
7. Seat: EPDM or NBR. See Part 3 check valve schedule articles.

KK. Check Valves, Lead Free, Dual-Plate Type - Iron, with Resilient Seat, Class 300:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

    a. Keckley Company
    b. Shurjoint; a part of Aalberts Integrated Piping Systems
    c. Sure Flow Equipment Inc

2. Basis-of-Design Product: Subject to compliance with requirements, provide Insert manufacturer's name; product name or designation or comparable product by one of the following:

    a. Keckley Company
    b. Shurjoint; a part of Aalberts Integrated Piping Systems
    c. Sure Flow Equipment Inc

3. Standard: API 594.
4. CWP Rating: **500 psig**.
5. Body Design: Wafer, spring-loaded plates.

6. Body Material: ASTM A395/A395M or ASTM A536, ductile iron.
7. Seat: EPDM or NBR. See Part 3 check valve schedule articles.

LL. Check Valves, Lead Free - CPVC, Union-Type Ball Check:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

    a. American Valve, Inc
    b. Asahi/America
    c. GF Piping Systems
    d. Hayward Flow Control; Hayward Industries, Inc.
    e. IPEX USA LLC
    f. NIBCO INC.
    g. Spears Manufacturing Company
    h. Thermoplastic Valves, Inc

2. Basis-of-Design Product: Subject to compliance with requirements, provide check valve or comparable product by one of the following:

    a. American Valve, Inc
    b. Asahi/America
    c. GF Piping Systems
    d. Hayward Flow Control; Hayward Industries, Inc.
    e. IPEX USA LLC
    f. NIBCO INC.
    g. Spears Manufacturing Company
    h. Thermoplastic Valves, Inc

3. Pressure Rating and Temperature: **125 psig**, **150 psig**, or other pressure at **73 deg F** or other temperature. See Part 3 check valve schedule articles.
4. Body Material: CPVC.
5. Body Design: Union-type ball check.
6. End Connections for Valves NPS 2 (DN 50) and Smaller: Detachable, socket or threaded. See Part 3 check valve schedule articles.
7. End Connections for Valves NPS 2-1/2 to NPS 4 (DN 65 to DN 100): Detachable, socket, socket or threaded, threaded, flanged. See Part 3 check valve schedule articles.
8. Ball: CPVC.
9. Seals: EPDM- or FKM-rubber O-rings.

MM. Check Valves, Lead Free - PVC, Union-Type Ball Check:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

    a. American Valve, Inc
    b. Asahi/America
    c. GF Piping Systems

d. Hayward Flow Control; Hayward Industries, Inc.
e. IPEX USA LLC
f. NIBCO INC.
g. Spears Manufacturing Company
h. Thermoplastic Valves, Inc

2. Basis-of-Design Product: Subject to compliance with requirements, provide check valve or comparable product by one of the following:

a. American Valve, Inc
b. Asahi/America
c. GF Piping Systems
d. Hayward Flow Control; Hayward Industries, Inc.
e. IPEX USA LLC
f. NIBCO INC.
g. Spears Manufacturing Company
h. Thermoplastic Valves, Inc

3. Pressure Rating and Temperature: **125 psig**, **150 psig**, or other pressure at **73 deg F** or other temperature. See Part 3 check valve schedule articles.
4. Body Material: PVC.
5. Body Design: Union-type ball check.
6. End Connections for Valves NPS 2 (DN 50) and Smaller: Detachable, socket or threaded. See Part 3 check valve schedule articles.
7. End Connections for Valves NPS 2-1/2 to NPS 4 (DN 65 to DN 100): Detachable, socket or threaded.
8. Ball: PVC.
9. Seals: EPDM- or FKM-rubber O-rings.

2.7 CHECK VALVES, GENERAL PURPOSE

A. Check Valves, Lift Type, Threaded or Soldered Ends - Bronze, with Bronze Disc, Class 125:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. A.Y. McDonald Mfg. Co.
b. American Valve, Inc
c. Apollo Valves; a part of Aalberts Integrated Piping Systems
d. Crane Fluid Systems; Crane Co.
e. Flomatic Valves; Flomatic Corporation
f. Jenkins Valves; a Crane Co. brand
g. Jomar Valve
h. Keckley Company
i. Metraflex Company (The)
j. Milwaukee Valve Company
k. NIBCO INC.
l. Stockham; a Crane Co. brand

m. Val-Matic Valve & Manufacturing Corp.
n. Victaulic Company
o. WATTS; A Watts Water Technologies Company

2. Basis-of-Design Product: Subject to compliance with requirements, provide check valve or comparable product by one of the following:

a. A.Y. McDonald Mfg. Co.
b. American Valve, Inc
c. Apollo Valves; a part of Aalberts Integrated Piping Systems
d. Crane Fluid Systems; Crane Co.
e. Flomatic Valves; Flomatic Corporation
f. Jenkins Valves; a Crane Co. brand
g. Jomar Valve
h. Keckley Company
i. Metraflex Company (The)
j. Milwaukee Valve Company
k. NIBCO INC.
l. Stockham; a Crane Co. brand
m. Val-Matic Valve & Manufacturing Corp.
n. Victaulic Company
o. WATTS; A Watts Water Technologies Company

3. Standard: MSS SP-80, Type 1.
4. CWP Rating: **200 psig**.
5. Body Design: Vertical flow.
6. Body Material: ASTM B61 or ASTM B62, bronze.
7. Ends: Threaded or soldered ends. See Part 3 check valve schedule articles.
8. Disc: Bronze.

B. Check Valves, Lift Type, Threaded or Soldered Ends - Bronze, with Nonmetallic Disc, Class 125:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Crane Fluid Systems; Crane Co.
b. Jenkins Valves; a Crane Co. brand
c. Jomar Valve
d. Keckley Company
e. Lance Valves
f. Milwaukee Valve Company
g. NIBCO INC.
h. Red-White Valve Corp.
i. Stockham; a Crane Co. brand
j. Val-Matic Valve & Manufacturing Corp.
k. Victaulic Company

2. Basis-of-Design Product: Subject to compliance with requirements, provide check valve or comparable product by one of the following:

a. Crane Fluid Systems; Crane Co.
b. Jenkins Valves; a Crane Co. brand
c. Jomar Valve
d. Keckley Company
e. Lance Valves
f. Milwaukee Valve Company
g. NIBCO INC.
h. Red-White Valve Corp.
i. Stockham; a Crane Co. brand
j. Val-Matic Valve & Manufacturing Corp.
k. Victaulic Company

3. Standard: MSS SP-80, Type 2.
4. CWP Rating: **200 psig**.
5. Body Design: Vertical flow.
6. Body Material: ASTM B61 or ASTM B62, bronze.
7. Ends: Threaded or soldered ends. See Part 3 check valve schedule articles.
8. Disc: NBR or PTFE.

C. Check Valves, Swing Type, Threaded or Soldered Ends - Bronze, with Bronze Disc, Class 125:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Apollo Valves; a part of Aalberts Integrated Piping Systems
b. Crane Fluid Systems; Crane Co.
c. Jenkins Valves; a Crane Co. brand
d. Jomar Valve
e. Keckley Company
f. Lance Valves
g. Milwaukee Valve Company
h. NIBCO INC.
i. Red-White Valve Corp.
j. Shurjoint; a part of Aalberts Integrated Piping Systems
k. Stockham; a Crane Co. brand
l. Val-Matic Valve & Manufacturing Corp.
m. Victaulic Company

2. Basis-of-Design Product: Subject to compliance with requirements, provide check valve or comparable product by one of the following:

a. Apollo Valves; a part of Aalberts Integrated Piping Systems
b. Crane Fluid Systems; Crane Co.
c. Jenkins Valves; a Crane Co. brand
d. Jomar Valve
e. Keckley Company
f. Lance Valves
g. Milwaukee Valve Company
h. NIBCO INC.

i. Red-White Valve Corp.
j. Shurjoint; a part of Aalberts Integrated Piping Systems
k. Stockham; a Crane Co. brand
l. Val-Matic Valve & Manufacturing Corp.
m. Victaulic Company

3. Standard: MSS SP-80, Type 3.
4. CWP Rating: **200 psig**.
5. Body Design: Horizontal flow.
6. Body Material: ASTM B62, bronze.
7. Ends: Threaded or soldered ends. See Part 3 check valve schedule articles.
8. Disc: Bronze.

D. Check Valves, Swing Type, Threaded or Soldered Ends - Bronze, with Nonmetallic Disc, Class 125:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Apollo Valves; a part of Aalberts Integrated Piping Systems
b. Crane Fluid Systems; Crane Co.
c. Jenkins Valves; a Crane Co. brand
d. Jomar Valve
e. Keckley Company
f. Lance Valves
g. Milwaukee Valve Company
h. NIBCO INC.
i. Powell Valves
j. Red-White Valve Corp.
k. Stockham; a Crane Co. brand

2. Basis-of-Design Product: Subject to compliance with requirements, provide check valve or comparable product by one of the following:

a. Apollo Valves; a part of Aalberts Integrated Piping Systems
b. Crane Fluid Systems; Crane Co.
c. Jenkins Valves; a Crane Co. brand
d. Jomar Valve
e. Keckley Company
f. Lance Valves
g. Milwaukee Valve Company
h. NIBCO INC.
i. Powell Valves
j. Red-White Valve Corp.
k. Stockham; a Crane Co. brand

3. Standard: MSS SP-80, Type 4.
4. CWP Rating: **200 psig**.
5. Body Design: Horizontal flow.
6. Body Material: ASTM B62, bronze.

7. Ends: Threaded or soldered ends. See Part 3 check valve schedule articles.
8. Disc: PTFE.

E. Check Valves, Swing Type, Threaded or Soldered Ends - Bronze, with Bronze Disc, Class 150:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

   a. A.Y. McDonald Mfg. Co.
   b. Apollo Valves; a part of Aalberts Integrated Piping Systems
   c. Crane Fluid Systems; Crane Co.
   d. Hammond Valve
   e. Jenkins Valves; a Crane Co. brand
   f. Jomar Valve
   g. Lance Valves
   h. Legend Valve & Fitting, Inc
   i. Milwaukee Valve Company
   j. NIBCO INC.
   k. Powell Valves
   l. Red-White Valve Corp.
   m. Stockham; a Crane Co. brand

2. Basis-of-Design Product: Subject to compliance with requirements, provide check valve or comparable product by one of the following:

   a. A.Y. McDonald Mfg. Co.
   b. Apollo Valves; a part of Aalberts Integrated Piping Systems
   c. Crane Fluid Systems; Crane Co.
   d. Hammond Valve
   e. Jenkins Valves; a Crane Co. brand
   f. Jomar Valve
   g. Lance Valves
   h. Legend Valve & Fitting, Inc
   i. Milwaukee Valve Company
   j. NIBCO INC.
   k. Powell Valves
   l. Red-White Valve Corp.
   m. Stockham; a Crane Co. brand

3. Standard: MSS SP-80, Type 3.
4. CWP Rating: **300 psig**.
5. Body Design: Horizontal flow.
6. Body Material: ASTM B62, bronze.
7. Ends: Threaded or soldered ends. See Part 3 check valve schedule articles.
8. Disc: Bronze.

F. Check Valves, Swing Type, Threaded or Soldered Ends - Bronze, with Nonmetallic Disc, Class 150:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

    a. Crane Fluid Systems; Crane Co.
    b. Jenkins Valves; a Crane Co. brand
    c. Jomar Valve
    d. Lance Valves
    e. Milwaukee Valve Company
    f. NIBCO INC.
    g. Powell Valves
    h. Red-White Valve Corp.
    i. Stockham; a Crane Co. brand

2. Basis-of-Design Product: Subject to compliance with requirements, provide check valve or comparable product by one of the following:

    a. Crane Fluid Systems; Crane Co.
    b. Jenkins Valves; a Crane Co. brand
    c. Jomar Valve
    d. Lance Valves
    e. Milwaukee Valve Company
    f. NIBCO INC.
    g. Powell Valves
    h. Red-White Valve Corp.
    i. Stockham; a Crane Co. brand

3. Standard: MSS SP-80, Type 4.
4. CWP Rating: **300 psig**.
5. Body Design: Horizontal flow.
6. Body Material: ASTM B62, bronze.
7. Ends: Threaded or soldered ends. See Part 3 check valve schedule articles.
8. Disc: PTFE.

G. Check Valves, Swing Type, Flanged Ends - Iron, with Metal Seats, Class 125:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

    a. Anvil; an ASC Engineered Solution
    b. Apollo Valves; a part of Aalberts Integrated Piping Systems
    c. Clow Valve Company; a subsidiary of McWane, Inc.
    d. Cooper Valves
    e. Crane Fluid Systems; Crane Co.
    f. DeZURIK
    g. FNW; Ferguson Enterprises, Inc.
    h. GA Industries, Inc
    i. Hammond Valve
    j. Jenkins Valves; a Crane Co. brand
    k. Jomar Valve

l. Kennedy Valve Company; a division of McWane, Inc.
m. KITZ Corporation
n. Lance Valves
o. Milwaukee Valve Company
p. Powell Valves
q. Victaulic Company

2. Basis-of-Design Product: Subject to compliance with requirements, provide check valve or comparable product by one of the following:

a. Anvil; an ASC Engineered Solution
b. Apollo Valves; a part of Aalberts Integrated Piping Systems
c. Clow Valve Company; a subsidiary of McWane, Inc.
d. Cooper Valves
e. Crane Fluid Systems; Crane Co.
f. DeZURIK
g. FNW; Ferguson Enterprises, Inc.
h. GA Industries, Inc
i. Hammond Valve
j. Jenkins Valves; a Crane Co. brand
k. Jomar Valve
l. Kennedy Valve Company; a division of McWane, Inc.
m. KITZ Corporation
n. Lance Valves
o. Milwaukee Valve Company
p. Powell Valves
q. Victaulic Company

3. Standard: MSS SP-71, Type I.
4. CWP Rating, NPS 2-1/2 to NPS 12 (DN 65 to DN 300): **200 psig**.
5. CWP Rating, NPS 14 to NPS 24 (DN 350 to DN 600): **150 psig**.
6. Body Design: Clear or full waterway.
7. Body Material: ASTM A126, gray iron with bolted bonnet.
8. Ends: Flanged.
9. Trim: Bronze.
10. Gasket: Asbestos free.

H. Check Valves, Swing Type, Flanged Ends - Iron, with Nonmetallic-to-Metal Seats, Class 125:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Cooper Valves
b. Crane Fluid Systems; Crane Co.
c. DeZURIK
d. Kennedy Valve Company; a division of McWane, Inc.
e. KITZ Corporation
f. Lance Valves
g. Tyco Fire Products; brand of Johnson Controls International plc, Building

Solutions North America
h. Victaulic Company

2. Basis-of-Design Product: Subject to compliance with requirements, provide check valve or comparable product by one of the following:

a. Cooper Valves
b. Crane Fluid Systems; Crane Co.
c. DeZURIK
d. Kennedy Valve Company; a division of McWane, Inc.
e. KITZ Corporation
f. Lance Valves
g. Tyco Fire Products; brand of Johnson Controls International plc, Building Solutions North America
h. Victaulic Company

3. Standard: MSS SP-71, Type I.
4. CWP Rating, NPS 2-1/2 to NPS 12 (DN 65 to DN 300): **200 psig**.
5. CWP Rating, NPS 14 to NPS 24 (DN 350 to DN 600): **150 psig**.
6. Body Design: Clear or full waterway.
7. Body Material: ASTM A126, gray iron with bolted bonnet.
8. Ends: Flanged.
9. Trim: Composition.
10. Seat Ring: Bronze.
11. Disc Holder: Bronze.
12. Disc: PTFE.
13. Gasket: Asbestos free.

I. Check Valves, Swing Type, Flanged Ends - Iron, with Metal Seats, Class 250:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Apollo Valves; a part of Aalberts Integrated Piping Systems
b. Cooper Valves
c. Crane Fluid Systems; Crane Co.
d. Crispin Valve
e. DeZURIK
f. FNW; Ferguson Enterprises, Inc.
g. GA Industries, Inc
h. Hammond Valve
i. Jenkins Valves; a Crane Co. brand
j. KITZ Corporation
k. Lance Valves
l. Milwaukee Valve Company
m. Powell Valves
n. Victaulic Company

2. Basis-of-Design Product: Subject to compliance with requirements, provide check valve or comparable product by one of the following:

a. Apollo Valves; a part of Aalberts Integrated Piping Systems
b. Cooper Valves
c. Crane Fluid Systems; Crane Co.
d. Crispin Valve
e. DeZURIK
f. FNW; Ferguson Enterprises, Inc.
g. GA Industries, Inc
h. Hammond Valve
i. Jenkins Valves; a Crane Co. brand
j. KITZ Corporation
k. Lance Valves
l. Milwaukee Valve Company
m. Powell Valves
n. Victaulic Company

3. Standard: MSS SP-71, Type I.
4. CWP Rating, NPS 2-1/2 to NPS 12 (DN 65 to DN 300): **500 psig**.
5. CWP Rating, NPS 14 to NPS 24 (DN 350 to DN 600): **300 psig**.
6. Body Design: Clear or full waterway.
7. Body Material: ASTM A126, gray iron with bolted bonnet.
8. Ends: Flanged.
9. Trim: Bronze.
10. Gasket: Asbestos free.

J. Check Valves, Swing Type, Flanged Ends - Iron, with Lever- and Spring-Closure Control, Class 125:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Apollo Valves; a part of Aalberts Integrated Piping Systems
b. Clow Valve Company; a subsidiary of McWane, Inc.
c. Cooper Valves
d. Crispin Valve
e. DeZURIK
f. GA Industries, Inc
g. Kennedy Valve Company; a division of McWane, Inc.

2. Basis-of-Design Product: Subject to compliance with requirements, provide check valve or comparable product by one of the following:

a. Apollo Valves; a part of Aalberts Integrated Piping Systems
b. Clow Valve Company; a subsidiary of McWane, Inc.
c. Cooper Valves
d. Crispin Valve
e. DeZURIK
f. GA Industries, Inc
g. Kennedy Valve Company; a division of McWane, Inc.

3. Standard: MSS SP-71, Type I.

4. CWP Rating, NPS 2-1/2 to NPS 12 (DN 65 to DN 300): **200 psig**.
5. CWP Rating, NPS 14 to NPS 24 (DN 350 to DN 600): **150 psig**.
6. Body Design: Clear or full waterway.
7. Body Material: ASTM A126, gray iron with bolted bonnet.
8. Ends: Flanged.
9. Trim: Bronze.
10. Gasket: Asbestos free.
11. Closure Control: Factory-installed, exterior lever and spring.

K. Check Valves, Swing Type, Flanged Ends - Iron, with Lever- and Weight-Closure Control, Class 125:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

    a. Apollo Valves; a part of Aalberts Integrated Piping Systems
    b. Clow Valve Company; a subsidiary of McWane, Inc.
    c. Cooper Valves
    d. Crispin Valve
    e. DeZURIK
    f. GA Industries, Inc
    g. Kennedy Valve Company; a division of McWane, Inc.
    h. Milwaukee Valve Company

2. Basis-of-Design Product: Subject to compliance with requirements, provide check valve or comparable product by one of the following:

    a. Apollo Valves; a part of Aalberts Integrated Piping Systems
    b. Clow Valve Company; a subsidiary of McWane, Inc.
    c. Cooper Valves
    d. Crispin Valve
    e. DeZURIK
    f. GA Industries, Inc
    g. Kennedy Valve Company; a division of McWane, Inc.
    h. Milwaukee Valve Company

3. Standard: MSS SP-71, Type I.
4. CWP Rating, NPS 2-1/2 to NPS 12 (DN 65 to DN 300): **200 psig**.
5. CWP Rating, NPS 14 to NPS 24 (DN 350 to DN 600): **150 psig**.
6. Body Design: Clear or full waterway.
7. Body Material: ASTM A126, gray iron with bolted bonnet.
8. Ends: Flanged.
9. Trim: Bronze.
10. Gasket: Asbestos free.
11. Closure Control: Factory-installed, exterior lever and weight.

L. Check Valves, Swing Type, Grooved Ends - Iron, 300 CWP:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include,

but are not limited to, the following:

a. Anvil; an ASC Engineered Solution
b. DeZURIK
c. Shurjoint; a part of Aalberts Integrated Piping Systems
d. Tyco Fire Products; brand of Johnson Controls International plc, Building Solutions North America
e. Victaulic Company

2. Basis-of-Design Product: Subject to compliance with requirements, provide Insert manufacturer's name; product name or designation or comparable product by one of the following:

a. Anvil; an ASC Engineered Solution
b. DeZURIK
c. Shurjoint; a part of Aalberts Integrated Piping Systems
d. Tyco Fire Products; brand of Johnson Controls International plc, Building Solutions North America
e. Victaulic Company

3. CWP Rating: **300 psig**.
4. Body Material: ASTM A536, ductile iron.
5. Seat: NBR.
6. Disc: Spring operated, ductile iron or stainless steel.

M. Check Valves, Dual-Plate Type - Iron, with Metal Seat, Class 125:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. ABZ Valve; an ASC Engineered Solution
b. Anvil; an ASC Engineered Solution
c. DeZURIK
d. Flomatic Valves; Flomatic Corporation
e. Jomar Valve
f. Keckley Company
g. Lance Valves
h. Legend Valve & Fitting, Inc
i. Metraflex Company (The)
j. Shurjoint; a part of Aalberts Integrated Piping Systems
k. Stockham; a Crane Co. brand
l. Sure Flow Equipment Inc

2. Basis-of-Design Product: Subject to compliance with requirements, provide check valve or comparable product by one of the following:

a. ABZ Valve; an ASC Engineered Solution
b. Anvil; an ASC Engineered Solution
c. DeZURIK
d. Flomatic Valves; Flomatic Corporation

e. Jomar Valve
f. Keckley Company
g. Lance Valves
h. Legend Valve & Fitting, Inc
i. Metraflex Company (The)
j. Shurjoint; a part of Aalberts Integrated Piping Systems
k. Stockham; a Crane Co. brand
l. Sure Flow Equipment Inc

3. Standard: API 594.
4. CWP Rating, NPS 2-1/2 to NPS 12 (DN 65 to DN 300): **200 psig**.
5. CWP Rating, NPS 14 to NPS 24 (DN 350 to DN 600): **150 psig**.
6. Body Design: Wafer, spring-loaded plates.
7. Body Material: ASTM A126, gray iron.
8. Seat: Bronze.

N. Check Valves, Dual-Plate Type - Iron, with Metal Seat, Class 150:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. ABZ Valve; an ASC Engineered Solution
b. Anvil; an ASC Engineered Solution
c. DeZURIK
d. Jomar Valve
e. Keckley Company
f. Lance Valves
g. Legend Valve & Fitting, Inc
h. Metraflex Company (The)
i. Stockham; a Crane Co. brand
j. Sure Flow Equipment Inc

2. Basis-of-Design Product: Subject to compliance with requirements, provide check valve or comparable product by one of the following:

a. ABZ Valve; an ASC Engineered Solution
b. Anvil; an ASC Engineered Solution
c. DeZURIK
d. Jomar Valve
e. Keckley Company
f. Lance Valves
g. Legend Valve & Fitting, Inc
h. Metraflex Company (The)
i. Stockham; a Crane Co. brand
j. Sure Flow Equipment Inc

3. Standard: API 594.
4. CWP Rating, NPS 2-1/2 to NPS 12 (DN 65 to DN 300): **300 psig**.
5. CWP Rating, NPS 14 to NPS 24 (DN 350 to DN 600): **250 psig**.
6. Body Design: Wafer, spring-loaded plates.

7. Body Material: ASTM A395/A395M or ASTM A536, ductile iron.
8. Seat: Bronze.

O. Check Valves, Dual-Plate Type - Iron, with Metal Seat, Class 250:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

   a. ABZ Valve; an ASC Engineered Solution
   b. Anvil; an ASC Engineered Solution
   c. Keckley Company
   d. Stockham; a Crane Co. brand
   e. Sure Flow Equipment Inc
   f. Val-Matic Valve & Manufacturing Corp.

2. Basis-of-Design Product: Subject to compliance with requirements, provide Insert manufacturer's name; product name or designation or comparable product by one of the following:

   a. ABZ Valve; an ASC Engineered Solution
   b. Anvil; an ASC Engineered Solution
   c. Keckley Company
   d. Stockham; a Crane Co. brand
   e. Sure Flow Equipment Inc
   f. Val-Matic Valve & Manufacturing Corp.

3. Standard: API 594.
4. CWP Rating, NPS 2-1/2 to NPS 12 (DN 65 to DN 300): **400 psig**.
5. CWP Rating, NPS 14 to NPS 24 (DN 350 to DN 600): **300 psig**.
6. Body Design: Wafer, spring-loaded plates.
7. Body Material: ASTM A126, gray iron.
8. Seat: Bronze.

P. Check Valves, Dual-Plate Type - Iron, with Metal Seat, Class 300:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

   a. ABZ Valve; an ASC Engineered Solution
   b. Anvil; an ASC Engineered Solution
   c. Keckley Company
   d. Shurjoint; a part of Aalberts Integrated Piping Systems
   e. Sure Flow Equipment Inc

2. Basis-of-Design Product: Subject to compliance with requirements, provide Insert manufacturer's name; product name or designation or comparable product by one of the following:

   a. ABZ Valve; an ASC Engineered Solution

b. Anvil; an ASC Engineered Solution
c. Keckley Company
d. Shurjoint; a part of Aalberts Integrated Piping Systems
e. Sure Flow Equipment Inc

3. Standard: API 594.
4. CWP Rating, NPS 2-1/2 to NPS 12 (DN 65 to DN 300): **500 psig**.
5. CWP Rating, NPS 14 to NPS 24 (DN 350 to DN 600): **400 psig**.
6. Body Design: Wafer, spring-loaded plates.
7. Body Material: ASTM A395/A395M or ASTM A536, ductile iron.
8. Seat: Bronze.

Q. Check Valves, Single-Plate Type - Iron, with Resilient Seat, Class 125:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. GA Industries, Inc
b. Jomar Valve
c. Keckley Company

2. Basis-of-Design Product: Subject to compliance with requirements, provide check valve or comparable product by one of the following:

a. GA Industries, Inc
b. Jomar Valve
c. Keckley Company

3. Standard: API 594.
4. CWP Rating, NPS 2-1/2 to NPS 12 (DN 65 to DN 300): **200 psig**.
5. CWP Rating, NPS 14 to NPS 24 (DN 350 to DN 600): **150 psig**.
6. Body Design: Wafer, single spring-loaded plate.
7. Body Material: ASTM A126, gray iron.
8. Seat: NBR.

R. Check Valves, Dual-Plate Type - Iron, with Resilient Seat, Class 125:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Flomatic Valves; Flomatic Corporation
b. Keckley Company
c. Stockham; a Crane Co. brand
d. Sure Flow Equipment Inc

2. Basis-of-Design Product: Subject to compliance with requirements, provide check valve or comparable product by one of the following:

a. Flomatic Valves; Flomatic Corporation

b. Keckley Company
c. Stockham; a Crane Co. brand
d. Sure Flow Equipment Inc

3. Standard: API 594.
4. CWP Rating, NPS 2-1/2 to NPS 12 (DN 65 to DN 300): **200 psig**.
5. CWP Rating, NPS 14 to NPS 24 (DN 350 to DN 600): **150 psig**.
6. Body Design: Wafer, spring-loaded plates.
7. Body Material: ASTM A126, gray iron.
8. Seat: NBR.

S. Check Valves, Dual-Plate Type - Iron, with Resilient Seat, Class 150:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. DeZURIK
b. Keckley Company
c. Stockham; a Crane Co. brand
d. Sure Flow Equipment Inc

2. Basis-of-Design Product: Subject to compliance with requirements, provide check valve or comparable product by one of the following:

a. DeZURIK
b. Keckley Company
c. Stockham; a Crane Co. brand
d. Sure Flow Equipment Inc

3. Standard: API 594.
4. CWP Rating, NPS 2-1/2 to NPS 12 (DN 65 to DN 300): **300 psig**.
5. CWP Rating, NPS 14 to NPS 24 (DN 350 to DN 600): **250 psig**.
6. Body Design: Wafer, spring-loaded plates.
7. Body Material: ASTM A395/A395M or ASTM A536, ductile iron.
8. Seat: NBR.

T. Check Valves, Single-Plate Type - Iron, with Resilient Seat, Class 250:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. GA Industries, Inc
b. Jomar Valve
c. Keckley Company
d. Victaulic Company

2. Basis-of-Design Product: Subject to compliance with requirements, provide check valve or comparable product by one of the following:

a. GA Industries, Inc
b. Jomar Valve
c. Keckley Company
d. Victaulic Company

3. Standard: API 594.
4. CWP Rating, NPS 2-1/2 to NPS 12 (DN 65 to DN 300): **400 psig**.
5. CWP Rating, NPS 14 to NPS 24 (DN 350 to DN 600): **300 psig**.
6. Body Design: Wafer, single spring-loaded plate.
7. Body Material: ASTM A126, gray iron.
8. Seat: NBR.

U. Check Valves, Dual-Plate Type - Iron, with Resilient Seat, Class 250:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Jomar Valve
b. Keckley Company
c. Stockham; a Crane Co. brand
d. Sure Flow Equipment Inc
e. Val-Matic Valve & Manufacturing Corp.

2. Basis-of-Design Product: Subject to compliance with requirements, provide check valve or comparable product by one of the following:

a. Jomar Valve
b. Keckley Company
c. Stockham; a Crane Co. brand
d. Sure Flow Equipment Inc
e. Val-Matic Valve & Manufacturing Corp.

3. Standard: API 594.
4. CWP Rating, NPS 2-1/2 to NPS 12 (DN 65 to DN 300): **400 psig**.
5. CWP Rating, NPS 14 to NPS 24 (DN 350 to DN 600): **300 psig**.
6. Body Design: Wafer, spring-loaded plates.
7. Body Material: ASTM A126, gray iron.
8. Seat: NBR.

V. Check Valves, Dual-Plate Type - Iron, with Resilient Seat, Class 300:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Keckley Company
b. Shurjoint; a part of Aalberts Integrated Piping Systems
c. Sure Flow Equipment Inc

2. Basis-of-Design Product: Subject to compliance with requirements, provide

check valve or comparable product by one of the following:

a. Keckley Company
b. Shurjoint; a part of Aalberts Integrated Piping Systems
c. Sure Flow Equipment Inc

3. Standard: API 594.
4. CWP Rating, NPS 2-1/2 to NPS 12 (DN 65 to DN 300): **500 psig**.
5. CWP Rating, NPS 14 to NPS 24 (DN 350 to DN 600): **400 psig**.
6. Body Design: Wafer, spring-loaded plates.
7. Body Material: ASTM A395/A395M or ASTM A536, ductile iron.
8. Seat: NBR.

2.8 GATE VALVES, LEAD FREE

A. Gate Valves, Lead Free, Threaded or Soldered Ends - Bronze, NRS, Class 125:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. American Valve, Inc
b. Apollo Valves; a part of Aalberts Integrated Piping Systems
c. Crane Fluid Systems; Crane Co.
d. Jenkins Valves; a Crane Co. brand
e. KITZ Corporation
f. Lance Valves
g. Milwaukee Valve Company
h. Powell Valves
i. Red-White Valve Corp.
j. Stockham; a Crane Co. brand
k. WATTS; A Watts Water Technologies Company

2. Basis-of-Design Product: Subject to compliance with requirements, provide gate valve or comparable product by one of the following:

a. American Valve, Inc
b. Apollo Valves; a part of Aalberts Integrated Piping Systems
c. Crane Fluid Systems; Crane Co.
d. Jenkins Valves; a Crane Co. brand
e. KITZ Corporation
f. Lance Valves
g. Milwaukee Valve Company
h. Powell Valves
i. Red-White Valve Corp.
j. Stockham; a Crane Co. brand
k. WATTS; A Watts Water Technologies Company

3. Standard: MSS SP-80, Type 1.
4. CWP Rating: **200 psig**.

5. Body Material: Bronze with integral seat and screw-in bonnet.
6. Ends: Threaded or solder joint. See Part 3 gate valve schedule articles.
7. Stem: Bronze.
8. Disc: Solid wedge, bronze.
9. Packing: Asbestos free.
10. Handwheel: Malleable iron , bronze, or aluminum.

B. Gate Valves, Lead Free, Threaded or Soldered Ends - Bronze, RS, Class 125:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

    a. Apollo Valves; a part of Aalberts Integrated Piping Systems
    b. Crane Fluid Systems; Crane Co.
    c. Hammond Valve
    d. Jenkins Valves; a Crane Co. brand
    e. KITZ Corporation
    f. Milwaukee Valve Company
    g. NIBCO INC.
    h. Powell Valves
    i. Stockham; a Crane Co. brand
    j. WATTS; A Watts Water Technologies Company

2. Basis-of-Design Product: Subject to compliance with requirements, provide gate valve or comparable product by one of the following:

    a. Apollo Valves; a part of Aalberts Integrated Piping Systems
    b. Crane Fluid Systems; Crane Co.
    c. Hammond Valve
    d. Jenkins Valves; a Crane Co. brand
    e. KITZ Corporation
    f. Milwaukee Valve Company
    g. NIBCO INC.
    h. Powell Valves
    i. Stockham; a Crane Co. brand
    j. WATTS; A Watts Water Technologies Company

3. Standard: MSS SP-80, Type 2.
4. CWP Rating: **200 psig**.
5. Body Material: Bronze with integral seat and screw-in bonnet.
6. Ends: Threaded or solder joint. See Part 3 gate valve schedule articles.
7. Stem: Bronze.
8. Disc: Solid wedge, bronze.
9. Packing: Asbestos free.
10. Handwheel: Malleable iron, bronze, or aluminum.

C. Gate Valves, Lead Free, Threaded Ends - Bronze, NRS, Class 150:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include,

but are not limited to, the following:

a. American Valve, Inc
b. Apollo Valves; a part of Aalberts Integrated Piping Systems
c. Crane Fluid Systems; Crane Co.
d. Jenkins Valves; a Crane Co. brand
e. KITZ Corporation
f. Lance Valves
g. Milwaukee Valve Company
h. Powell Valves
i. Red-White Valve Corp.
j. Stockham; a Crane Co. brand
k. WATTS; A Watts Water Technologies Company

2. Basis-of-Design Product: Subject to compliance with requirements, provide gate valve or comparable product by one of the following:

a. American Valve, Inc
b. Apollo Valves; a part of Aalberts Integrated Piping Systems
c. Crane Fluid Systems; Crane Co.
d. Jenkins Valves; a Crane Co. brand
e. KITZ Corporation
f. Lance Valves
g. Milwaukee Valve Company
h. Powell Valves
i. Red-White Valve Corp.
j. Stockham; a Crane Co. brand
k. WATTS; A Watts Water Technologies Company

3. Standard: MSS SP-80, Type 1.
4. CWP Rating: **300 psig**.
5. Body Material: Bronze with integral seat and union-ring bonnet.
6. Ends: Threaded.
7. Stem: Bronze.
8. Disc: Solid wedge, bronze.
9. Packing: Asbestos free.
10. Handwheel: Malleable iron , bronze, or aluminum.

D. Gate Valves, Lead Free, Threaded Ends - Bronze, RS, Class 150:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Apollo Valves; a part of Aalberts Integrated Piping Systems
b. Crane Fluid Systems; Crane Co.
c. Hammond Valve
d. Jenkins Valves; a Crane Co. brand
e. KITZ Corporation
f. Milwaukee Valve Company
g. Powell Valves

h. Stockham; a Crane Co. brand
i. WATTS; A Watts Water Technologies Company

2. Basis-of-Design Product: Subject to compliance with requirements, provide gate valve or comparable product by one of the following:

a. Apollo Valves; a part of Aalberts Integrated Piping Systems
b. Crane Fluid Systems; Crane Co.
c. Hammond Valve
d. Jenkins Valves; a Crane Co. brand
e. KITZ Corporation
f. Milwaukee Valve Company
g. Powell Valves
h. Stockham; a Crane Co. brand
i. WATTS; A Watts Water Technologies Company

3. Standard: MSS SP-80, Type 2.
4. CWP Rating: **300 psig**.
5. Body Material: Bronze with integral seat and union-ring bonnet.
6. Ends: Threaded.
7. Stem: Bronze.
8. Disc: Solid wedge, bronze.
9. Packing: Asbestos free.
10. Handwheel: Malleable iron , bronze, or aluminum.

E. Gate Valves, Lead Free, Press Ends - Bronze:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Apollo Valves; a part of Aalberts Integrated Piping Systems
b. Elkhart Products Corporation; a part of Aalberts Integrated Piping Systems
c. Hammond Valve
d. Milwaukee Valve Company
e. NIBCO INC.

2. Basis-of-Design Product: Subject to compliance with requirements, provide gate valve or comparable product by one of the following:

a. Apollo Valves; a part of Aalberts Integrated Piping Systems
b. Elkhart Products Corporation; a part of Aalberts Integrated Piping Systems
c. Hammond Valve
d. Milwaukee Valve Company
e. NIBCO INC.

3. Standards: MSS SP-80 and MSS SP-139.
4. CWP Rating: Minimum **200 psig**.
5. Body Material: Bronze with integral seat and union-ring bonnet.
6. Ends: Press.
7. Press Ends Connection Rating: Minimum **200 psig**.

8. Stem: Brass or bronze, RS or NRS. See Part 3 gate valve schedule articles.
9. Disc: Solid wedge, bronze.
10. Packing: Graphite.
11. Port: Full.
12. Handwheel: Malleable iron, bronze, or aluminum.

F. Gate Valves, Lead Free, Flanged Ends - Iron, NRS, Class 125:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

    a. Apollo Valves; a part of Aalberts Integrated Piping Systems
    b. Clow Valve Company; a subsidiary of McWane, Inc.
    c. Cooper Valves
    d. Crane Fluid Systems; Crane Co.
    e. Flomatic Valves; Flomatic Corporation
    f. Jenkins Valves; a Crane Co. brand
    g. Jomar Valve
    h. Kennedy Valve Company; a division of McWane, Inc.
    i. KITZ Corporation
    j. Lance Valves
    k. Powell Valves
    l. Zurn Industries, LLC

2. Basis-of-Design Product: Subject to compliance with requirements, provide gate valve or comparable product by one of the following:

    a. Apollo Valves; a part of Aalberts Integrated Piping Systems
    b. Clow Valve Company; a subsidiary of McWane, Inc.
    c. Cooper Valves
    d. Crane Fluid Systems; Crane Co.
    e. Flomatic Valves; Flomatic Corporation
    f. Jenkins Valves; a Crane Co. brand
    g. Jomar Valve
    h. Kennedy Valve Company; a division of McWane, Inc.
    i. KITZ Corporation
    j. Lance Valves
    k. Powell Valves
    l. Zurn Industries, LLC

3. Standard: MSS SP-70, Type I.
4. CWP Rating: **200 psig**.
5. Body Material: Gray iron with bolted bonnet.
6. Ends: Flanged.
7. Trim: Bronze.
8. Disc: Solid wedge.
9. Packing and Gasket: Asbestos free.

G. Gate Valves, Lead Free, Flanged Ends - Iron, OS&Y, Class 125:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

    a. Apollo Valves; a part of Aalberts Integrated Piping Systems
    b. Crane Fluid Systems; Crane Co.
    c. Hammond Valve
    d. Jomar Valve
    e. Kennedy Valve Company; a division of McWane, Inc.
    f. KITZ Corporation
    g. Lance Valves
    h. Milwaukee Valve Company
    i. Powell Valves
    j. Tyco Fire Products; brand of Johnson Controls International plc, Building Solutions North America
    k. WATTS; A Watts Water Technologies Company
    l. Zurn Industries, LLC

2. Basis-of-Design Product: Subject to compliance with requirements, provide Insert manufacturer's name; product name or designation or comparable product by one of the following:

    a. Apollo Valves; a part of Aalberts Integrated Piping Systems
    b. Crane Fluid Systems; Crane Co.
    c. Hammond Valve
    d. Jomar Valve
    e. Kennedy Valve Company; a division of McWane, Inc.
    f. KITZ Corporation
    g. Lance Valves
    h. Milwaukee Valve Company
    i. Powell Valves
    j. Tyco Fire Products; brand of Johnson Controls International plc, Building Solutions North America
    k. WATTS; A Watts Water Technologies Company
    l. Zurn Industries, LLC

3. Standard: MSS SP-70, Type I.
4. CWP Rating: **200 psig**.
5. Body Material: Gray iron with bolted bonnet.
6. Ends: Flange.
7. Trim: Bronze.
8. Disc: Solid wedge.
9. Packing and Gasket: Asbestos free.

H. Gate Valves, Lead Free, Flanged Ends - Iron, NRS, Class 250:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

    a. Apollo Valves; a part of Aalberts Integrated Piping Systems

b. Clow Valve Company; a subsidiary of McWane, Inc.
c. Cooper Valves
d. Crane Fluid Systems; Crane Co.
e. Flomatic Valves; Flomatic Corporation
f. Jenkins Valves; a Crane Co. brand
g. KITZ Corporation
h. Victaulic Company
i. Zurn Industries, LLC

2. Basis-of-Design Product: Subject to compliance with requirements, provide gate valve or comparable product by one of the following:

a. Apollo Valves; a part of Aalberts Integrated Piping Systems
b. Clow Valve Company; a subsidiary of McWane, Inc.
c. Cooper Valves
d. Crane Fluid Systems; Crane Co.
e. Flomatic Valves; Flomatic Corporation
f. Jenkins Valves; a Crane Co. brand
g. KITZ Corporation
h. Victaulic Company
i. Zurn Industries, LLC

3. Standard: MSS SP-70, Type I.
4. CWP Rating: **500 psig**.
5. Body Material: Gray iron with bolted bonnet.
6. Ends: Flange.
7. Trim: Bronze.
8. Disc: Solid wedge.
9. Packing and Gasket: Asbestos free.

I. Gate Valves, Lead Free, Flanged Ends - Iron, OS&Y, Class 250:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Apollo Valves; a part of Aalberts Integrated Piping Systems
b. Crane Fluid Systems; Crane Co.
c. Hammond Valve
d. KITZ Corporation
e. Milwaukee Valve Company
f. Powell Valves
g. Tyco Fire Products; brand of Johnson Controls International plc, Building Solutions North America
h. Victaulic Company
i. WATTS; A Watts Water Technologies Company
j. Zurn Industries, LLC

2. Standard: MSS SP-70, Type I.
3. CWP Rating: **500 psig**.
4. Body Material: Gray iron with bolted bonnet.

5. Ends: Flanged.
6. Trim: Bronze.
7. Disc: Solid wedge.
8. Packing and Gasket: Asbestos free.
9. Basis-of-Design Product: Subject to compliance with requirements, provide gate valve or comparable product by one of the following:

    a. Apollo Valves; a part of Aalberts Integrated Piping Systems
    b. Crane Fluid Systems; Crane Co.
    c. Hammond Valve
    d. KITZ Corporation
    e. Milwaukee Valve Company
    f. Powell Valves
    g. Tyco Fire Products; brand of Johnson Controls International plc, Building Solutions North America
    h. Victaulic Company
    i. WATTS; A Watts Water Technologies Company
    j. Zurn Industries, LLC

J. Gate Valves - CPVC:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

    a. Asahi/America
    b. KITZ Corporation
    c. Spears Manufacturing Company

2. Basis-of-Design Product: Subject to compliance with requirements, provide gate valve or comparable product by one of the following:

    a. Asahi/America
    b. KITZ Corporation
    c. Spears Manufacturing Company

3. Pressure Rating and Temperature: **125 psig**, **150 psig**, or other pressure at **73 deg F** or other temperature. See Part 3 gate valve schedule articles.
4. Body Material: CPVC.
5. Body Design: NRS.
6. End Connections for Valves NPS 2 (DN 50) and Smaller: Socket or threaded. See Part 3 gate valve schedule articles.
7. End Connections for Valves NPS 2-1/2 to NPS 4 (DN 65 to DN 100): Socket, socket or threaded, threaded, flanged. See Part 3 gate valve schedule articles.
8. Gate and Stem: Plastic.
9. Seals: EPDM rubber.
10. Handle: Wheel.

K. Gate Valves - PVC:

1. Manufacturers: Subject to compliance with requirements, available

manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Asahi/America
b. KITZ Corporation
c. Spears Manufacturing Company

2. Basis-of-Design Product: Subject to compliance with requirements, provide gate valve or comparable product by one of the following:

a. Asahi/America
b. KITZ Corporation
c. Spears Manufacturing Company

3. Pressure Rating and Temperature: **125 psig**, **150 psig**, or other pressure at **73 deg F** or other temperature. See Part 3 gate valve schedule articles.
4. Body Material: PVC.
5. Body Design: NRS.
6. End Connections for Valves NPS 2 (DN 50) and Smaller: Socket or threaded. See Part 3 gate valve schedule articles.
7. End Connections for Valves NPS 2-1/2 to NPS 4 (DN 65 to DN 100): Socket, socket or threaded, threaded, or flanged.
8. Gate and Stem: Plastic.
9. Seals: EPDM rubber.
10. Handle: Wheel.

2.9 GATE VALVES, GENERAL PURPOSE

A. Gate Valves, Threaded or Soldered Ends - Bronze, NRS, Class 125:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. American Valve, Inc
b. Apollo Valves; a part of Aalberts Integrated Piping Systems
c. Crane Fluid Systems; Crane Co.
d. Jenkins Valves; a Crane Co. brand
e. KITZ Corporation
f. Lance Valves
g. Milwaukee Valve Company
h. Powell Valves
i. Red-White Valve Corp.
j. Stockham; a Crane Co. brand
k. WATTS; A Watts Water Technologies Company

2. Basis-of-Design Product: Subject to compliance with requirements, provide gate valve or comparable product by one of the following:

a. American Valve, Inc

b. Apollo Valves; a part of Aalberts Integrated Piping Systems
c. Crane Fluid Systems; Crane Co.
d. Jenkins Valves; a Crane Co. brand
e. KITZ Corporation
f. Lance Valves
g. Milwaukee Valve Company
h. Powell Valves
i. Red-White Valve Corp.
j. Stockham; a Crane Co. brand
k. WATTS; A Watts Water Technologies Company

3. Standard: MSS SP-80, Type 1.
4. CWP Rating: **200 psig**.
5. Body Material: ASTM B62, bronze with integral seat and screw-in bonnet.
6. Ends: Threaded or soldered joint. See Part 3 gate valve schedule articles.
7. Stem: Bronze.
8. Disc: Solid wedge, bronze.
9. Packing: Asbestos free.
10. Handwheel: Malleable iron , bronze, or aluminum.

B. Gate Valves, Threaded or Soldered Ends - Bronze, RS, Class 125:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Apollo Valves; a part of Aalberts Integrated Piping Systems
b. Crane Fluid Systems; Crane Co.
c. Hammond Valve
d. Jenkins Valves; a Crane Co. brand
e. KITZ Corporation
f. Milwaukee Valve Company
g. NIBCO INC.
h. Powell Valves
i. Red-White Valve Corp.
j. Stockham; a Crane Co. brand
k. WATTS; A Watts Water Technologies Company

2. Basis-of-Design Product: Subject to compliance with requirements, provide valve or comparable product by one of the following:

a. Apollo Valves; a part of Aalberts Integrated Piping Systems
b. Crane Fluid Systems; Crane Co.
c. Hammond Valve
d. Jenkins Valves; a Crane Co. brand
e. KITZ Corporation
f. Milwaukee Valve Company
g. NIBCO INC.
h. Powell Valves
i. Red-White Valve Corp.
j. Stockham; a Crane Co. brand

k. WATTS; A Watts Water Technologies Company

3. Standard: MSS SP-80, Type 2.
4. CWP Rating: **200 psig**.
5. Body Material: ASTM B62, bronze with integral seat and screw-in bonnet.
6. Ends: Threaded or soldered joint. See Part 3 gate valve schedule articles.
7. Stem: Bronze.
8. Disc: Solid wedge, bronze.
9. Packing: Asbestos free.
10. Handwheel: Malleable iron, bronze, or aluminum.

C. Gate Valves, Threaded Ends - Bronze, NRS, Class 150:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

   a. American Valve, Inc
   b. Apollo Valves; a part of Aalberts Integrated Piping Systems
   c. Crane Fluid Systems; Crane Co.
   d. Jenkins Valves; a Crane Co. brand
   e. KITZ Corporation
   f. Lance Valves
   g. Milwaukee Valve Company
   h. Powell Valves
   i. Red-White Valve Corp.
   j. Stockham; a Crane Co. brand
   k. WATTS; A Watts Water Technologies Company

2. Basis-of-Design Product: Subject to compliance with requirements, provide gate valve or comparable product by one of the following:

   a. American Valve, Inc
   b. Apollo Valves; a part of Aalberts Integrated Piping Systems
   c. Crane Fluid Systems; Crane Co.
   d. Jenkins Valves; a Crane Co. brand
   e. KITZ Corporation
   f. Lance Valves
   g. Milwaukee Valve Company
   h. Powell Valves
   i. Red-White Valve Corp.
   j. Stockham; a Crane Co. brand
   k. WATTS; A Watts Water Technologies Company

3. Standard: MSS SP-80, Type 1.
4. CWP Rating: **300 psig**.
5. Body Material: ASTM B62, bronze with integral seat and union-ring bonnet.
6. Ends: Threaded.
7. Stem: Bronze.
8. Disc: Solid wedge, bronze.
9. Packing: Asbestos free.

10. Handwheel: Malleable iron , bronze, or aluminum.

D. Gate Valves, Threaded Ends - Bronze, RS, Class 150:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

    a. Apollo Valves; a part of Aalberts Integrated Piping Systems
    b. Crane Fluid Systems; Crane Co.
    c. Hammond Valve
    d. Jenkins Valves; a Crane Co. brand
    e. KITZ Corporation
    f. Milwaukee Valve Company
    g. Powell Valves
    h. Stockham; a Crane Co. brand
    i. WATTS; A Watts Water Technologies Company

2. Basis-of-Design Product: Subject to compliance with requirements, provide gate valve or comparable product by one of the following:

    a. Apollo Valves; a part of Aalberts Integrated Piping Systems
    b. Crane Fluid Systems; Crane Co.
    c. Hammond Valve
    d. Jenkins Valves; a Crane Co. brand
    e. KITZ Corporation
    f. Milwaukee Valve Company
    g. Powell Valves
    h. Stockham; a Crane Co. brand
    i. WATTS; A Watts Water Technologies Company

3. Standard: MSS SP-80, Type 2.
4. CWP Rating: **300 psig**.
5. Body Material: ASTM B62, bronze with integral seat and union-ring bonnet.
6. Ends: Threaded.
7. Stem: Bronze.
8. Disc: Solid wedge, bronze.
9. Packing: Asbestos free.
10. Handwheel: Malleable iron , bronze, or aluminum.

E. Gate Valves, Flanged Ends - Iron, NRS, Class 125:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

    a. Apollo Valves; a part of Aalberts Integrated Piping Systems
    b. Clow Valve Company; a subsidiary of McWane, Inc.
    c. Cooper Valves
    d. Crane Fluid Systems; Crane Co.
    e. Flomatic Valves; Flomatic Corporation

f. FNW; Ferguson Enterprises, Inc.
g. Jenkins Valves; a Crane Co. brand
h. Jomar Valve
i. Kennedy Valve Company; a division of McWane, Inc.
j. KITZ Corporation
k. Lance Valves
l. Legend Valve & Fitting, Inc
m. Powell Valves
n. Zurn Industries, LLC

2. Basis-of-Design Product: Subject to compliance with requirements, provide gate valve or comparable product by one of the following:

a. Apollo Valves; a part of Aalberts Integrated Piping Systems
b. Clow Valve Company; a subsidiary of McWane, Inc.
c. Cooper Valves
d. Crane Fluid Systems; Crane Co.
e. Flomatic Valves; Flomatic Corporation
f. FNW; Ferguson Enterprises, Inc.
g. Jenkins Valves; a Crane Co. brand
h. Jomar Valve
i. Kennedy Valve Company; a division of McWane, Inc.
j. KITZ Corporation
k. Lance Valves
l. Legend Valve & Fitting, Inc
m. Powell Valves
n. Zurn Industries, LLC

3. Standard: MSS SP-70, Type I.
4. CWP Rating, NPS 2-1/2 to NPS 12 (DN 65 to DN 300): **200 psig**.
5. CWP Rating, NPS 14 to NPS 24 (DN 350 to DN 600): **150 psig**.
6. Body Material: ASTM A126, gray iron with bolted bonnet.
7. Ends: Flanged.
8. Trim: Bronze.
9. Disc: Solid wedge.
10. Packing and Gasket: Asbestos free.

F. Gate Valves, Flanged Ends - Iron, OS&Y, Class 125:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Apollo Valves; a part of Aalberts Integrated Piping Systems
b. Crane Fluid Systems; Crane Co.
c. FNW; Ferguson Enterprises, Inc.
d. Hammond Valve
e. Jomar Valve
f. Kennedy Valve Company; a division of McWane, Inc.
g. KITZ Corporation
h. Lance Valves

i. Legend Valve & Fitting, Inc
j. Milwaukee Valve Company
k. Powell Valves
l. Tyco Fire Products; brand of Johnson Controls International plc, Building Solutions North America
m. WATTS; A Watts Water Technologies Company

2. Basis-of-Design Product: Subject to compliance with requirements, provide gate valve or comparable product by one of the following:

a. Apollo Valves; a part of Aalberts Integrated Piping Systems
b. Crane Fluid Systems; Crane Co.
c. FNW; Ferguson Enterprises, Inc.
d. Hammond Valve
e. Jomar Valve
f. Kennedy Valve Company; a division of McWane, Inc.
g. KITZ Corporation
h. Lance Valves
i. Legend Valve & Fitting, Inc
j. Milwaukee Valve Company
k. Powell Valves
l. Tyco Fire Products; brand of Johnson Controls International plc, Building Solutions North America
m. WATTS; A Watts Water Technologies Company

3. Standard: MSS SP-70, Type I.
4. CWP Rating, NPS 2-1/2 to NPS 12 (DN 65 to DN 300): **200 psig**.
5. CWP Rating, NPS 14 to NPS 24 (DN 350 to DN 600): **150 psig**.
6. Body Material: ASTM A126, gray iron with bolted bonnet.
7. Ends: Flanged.
8. Trim: Bronze.
9. Disc: Solid wedge.
10. Packing and Gasket: Asbestos free.

G. Gate Valves, Flanged Ends - Iron, NRS, Class 250:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Apollo Valves; a part of Aalberts Integrated Piping Systems
b. Clow Valve Company; a subsidiary of McWane, Inc.
c. Cooper Valves
d. Crane Fluid Systems; Crane Co.
e. Flomatic Valves; Flomatic Corporation
f. FNW; Ferguson Enterprises, Inc.
g. Jenkins Valves; a Crane Co. brand
h. KITZ Corporation
i. Victaulic Company
j. Zurn Industries, LLC

2. Basis-of-Design Product: Subject to compliance with requirements, provide Insert manufacturer's name; product name or designation or comparable product by one of the following:

    a. Apollo Valves; a part of Aalberts Integrated Piping Systems
    b. Clow Valve Company; a subsidiary of McWane, Inc.
    c. Cooper Valves
    d. Crane Fluid Systems; Crane Co.
    e. Flomatic Valves; Flomatic Corporation
    f. FNW; Ferguson Enterprises, Inc.
    g. Jenkins Valves; a Crane Co. brand
    h. KITZ Corporation
    i. Victaulic Company
    j. Zurn Industries, LLC

3. Standard: MSS SP-70, Type I.
4. CWP Rating, NPS 2-1/2 to NPS 12 (DN 65 to DN 300): **500 psig**.
5. CWP Rating, NPS 14 to NPS 24 (DN 350 to DN 600): **300 psig**.
6. Body Material: ASTM A126, gray iron with bolted bonnet.
7. Ends: Flanged.
8. Trim: Bronze.
9. Disc: Solid wedge.
10. Packing and Gasket: Asbestos free.

H. Gate Valves, Flanged Ends - Iron, OS&Y, Class 250:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

    a. Apollo Valves; a part of Aalberts Integrated Piping Systems
    b. Crane Fluid Systems; Crane Co.
    c. FNW; Ferguson Enterprises, Inc.
    d. Hammond Valve
    e. KITZ Corporation
    f. Milwaukee Valve Company
    g. Powell Valves
    h. Tyco Fire Products; brand of Johnson Controls International plc, Building Solutions North America
    i. Victaulic Company
    j. WATTS; A Watts Water Technologies Company
    k. Zurn Industries, LLC

2. Basis-of-Design Product: Subject to compliance with requirements, provide gate valve or comparable product by one of the following:

    a. Apollo Valves; a part of Aalberts Integrated Piping Systems
    b. Crane Fluid Systems; Crane Co.
    c. FNW; Ferguson Enterprises, Inc.
    d. Hammond Valve
    e. KITZ Corporation

f. Milwaukee Valve Company
g. Powell Valves
h. Tyco Fire Products; brand of Johnson Controls International plc, Building Solutions North America
i. Victaulic Company
j. WATTS; A Watts Water Technologies Company
k. Zurn Industries, LLC

3. Standard: MSS SP-70, Type I.
4. CWP Rating, NPS 2-1/2 to NPS 12 (DN 65 to DN 300): **500 psig**.
5. CWP Rating, NPS 14 to NPS 24 (DN 350 to DN 600): **300 psig**.
6. Body Material: ASTM A126, gray iron with bolted bonnet.
7. Ends: Flanged.
8. Trim: Bronze.
9. Disc: Solid wedge.
10. Packing and Gasket: Asbestos free.

2.10 CHAINWHEELS

2.11 Ball Valves, Threaded Ends - Stainless Steel, Three Piece with Full Port

A. Basis-of-Design Product: Subject to compliance with requirements, provide chainwheels or comparable product by one of the following:

1. Legend Valve & Fitting, Inc

2.12 Butterfly Valves, Resilient-Seated

A. Basis-of-Design Product: Subject to compliance with requirements, provide chainwheel or comparable product by one of the following:

1. FNW; Ferguson Enterprises, Inc.

2.13 Butterfly Valves, Single-Flange, High-Performance, Class 150

A. Basis-of-Design Product: Subject to compliance with requirements, provide valve or comparable product by one of the following:

1. FNW; Ferguson Enterprises, Inc.

2.14 Check Valves, Swing Type, Cast Iron with Metal Seat, Class 125

A. Basis-of-Design Product: Subject to compliance with requirements, provide valve or comparable product by one of the following:

1. FNW; Ferguson Enterprises, Inc.

2.15 Check Valves, Swing Type, Carbon Steel with Metal Seat, Class 300

A. Basis-of-Design Product: Subject to compliance with requirements, provide valve or comparable product by one of the following:

1. FNW; Ferguson Enterprises, Inc.

2.16 Check Valves, Swing Type, Carbon Steel with Nonmetallic-to-Metal Seat, Class 150

A. Basis-of-Design Product: Subject to compliance with requirements, provide valve or comparable product by one of the following:

1. FNW; Ferguson Enterprises, Inc.

2.17 Gate Valves - Stainless Steel, NRS, Class 150

A. Basis-of-Design Product: Subject to compliance with requirements, provide valve or comparable product by one of the following:

1. FNW; Ferguson Enterprises, Inc.

2.18 Gate Valves - Stainless Steel, NRS, Class 200

A. Basis-of-Design Product: Subject to compliance with requirements, provide valve or comparable product by one of the following:

1. FNW; Ferguson Enterprises, Inc.

2.19 Gate Valves - Stainless Steel, RS, Class 300

A. Basis-of-Design Product: Subject to compliance with requirements, provide valve or comparable product by one of the following:

1. FNW; Ferguson Enterprises, Inc.

2.20 Gate Valves, OS&Y - Carbon Steel, RS, Class 150

A. Basis-of-Design Product: Subject to compliance with requirements, provide valve or comparable product by one of the following:

1. FNW; Ferguson Enterprises, Inc.

2.21 Gate Valves, OS&Y - Carbon Steel, RS, Class 300

A. Basis-of-Design Product: Subject to compliance with requirements, provide valve or comparable product by one of the following:

1. FNW; Ferguson Enterprises, Inc.

2.22 Check Valves, Lead Free, In-Line Spring Loaded, Press Ends - Brass

A. Basis-of-Design Product: Subject to compliance with requirements, provide valve or comparable product by one of the following:

1. Bonomi North America, Inc.

PART 3 - EXECUTION

3.1 INSTALLATION OF VALVES

A. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.

B. Provide support of piping adjacent to valves such that no force is imposed upon valves.

C. Locate valves for easy access and where not blocked by equipment, other piping, or building components.

D. For valves in horizontal piping, install valves with stem at or above center of pipe.

E. Install valves in position that does not project into aisles or block access to other equipment.

F. Install valves in position to allow full stem and actuator or manual operator movement.

G. Verify that joints of each valve have been properly installed and sealed to assure there is no leakage or damage.

H. Chainwheels: Install chainwheels on manual operators for butterfly globe and gate valves NPS 4 and larger and more than 96 inches above floor. Extend chains to 60 inches above finished floor.

I. Install check valves for proper direction of flow and as follows:

1. Check Valves: Center-guided type and plate type, in horizontal or vertical position, between flanges.
2. Check Valves, Swing Type: In horizontal position with hinge pin level.
3. Check Valves, Lift Type: With stem upright and plumb.

J. Valve Tags: Comply with requirements in Section 220553 "Identification for Plumbing Piping and Equipment" for valve tags and schedules.

K. Adhere to manufacturer's written installation instructions. When soldering or brazing valves, do not heat valves above maximum permitted temperature. Do not use solder with melting point temperature above valve manufacturer's written recommended maximum.

3.2 GENERAL REQUIREMENTS FOR VALVE APPLICATIONS

A. If valves with specified CWP ratings are unavailable, the same types of valves with higher CWP ratings may be substituted.

B. Select valves with the following end connections:

1. For Copper Tubing, NPS 2 (DN 50) and Smaller: Threaded ends except where solder-joint valve-end option or press-end option is indicated in valve schedules below.
2. For Copper Tubing, NPS 2-1/2 to NPS 4 (DN 65 to DN 100): Flanged ends except where threaded valve-end option is indicated in valve schedules below.
3. For Copper Tubing, NPS 5 (DN 125) and Larger: Flanged ends.
4. For Steel Piping, NPS 2 (DN 50) and Smaller: Threaded ends.
5. For Steel Piping, NPS 2-1/2 to NPS 4 (DN 65 to DN 100): Flanged ends except where threaded valve-end option is indicated in valve schedules below.
6. For Steel Piping, NPS 5 (DN 125) and Larger: Flanged ends.
7. For Stainless Steel Piping, NPS 2 (DN 50) and Smaller: Threaded ends.
8. For Stainless Steel Piping, NPS 2-1/2 to NPS 4 (DN 65 to DN 100): Flanged ends.
9. For Grooved-End Copper Tubing: Valve ends may be grooved.
10. For Grooved-End Steel Piping: Valve ends may be grooved.
11. Wafer-Type Valves: Flanged connections.

3.3 LOW-PRESSURE, COMPRESSED-AIR BALL VALVE SCHEDULE - 150 PSIG (1035 kPa) OR LESS

A. Pipe NPS 2 (DN 50) and Smaller:

1. Ball valves, threaded or soldered ends - brass, three piece with full port and brass trim; threaded ends.
2. Ball valves, threaded or soldered ends - brass, three piece with full port and stainless steel trim; soldered ends.
3. Ball valves, threaded or soldered ends - brass, two piece with full port and brass trim; soldered ends.
4. Ball valves, threaded or soldered ends - brass, two piece with full port and stainless steel trim; threaded ends.
5. Ball valves, threaded or flanged ends - stainless steel, two piece with full port; threaded ends.
6. Ball valves, threaded ends - bronze, two piece, safety exhaust; 200 psig.

B. Pipe NPS 2-1/2 (DN 65) and Larger:

1. Ball valves, flanged ends - steel, with full port and stainless steel trim, Class 150.
2. Ball valves, flanged ends - steel, with full port and stainless steel trim, Class 300.
3. Ball valves, flanged ends - iron, Class 125.
4. Ball valves, threaded or flanged ends - stainless steel, two piece with full port; threaded ends.

3.4 HIGH-PRESSURE, COMPRESSED-AIR BALL VALVE SCHEDULE - 150 TO 200 PSIG (1035 TO 1380 kPa)

A. Pipe NPS 2 (DN 50) and Smaller:

1. Ball valves, threaded or soldered ends - brass, three piece with full port and brass trim; threaded ends.
2. Ball valves, threaded or soldered ends - brass, three piece with full port and stainless steel trim; threaded ends.
3. Ball valves, threaded or soldered ends - brass, two piece with full port and brass trim; threaded ends.
4. Ball valves, threaded or soldered ends - brass, two piece with full port and stainless steel trim; threaded ends.
5. Ball valves, threaded or flanged ends - stainless steel, two piece with full port; threaded ends.
6. Ball valves, threaded ends - bronze, two piece, safety exhaust; 200 psig.

B. Pipe NPS 2-1/2 (DN 65) and Larger:

1. Ball valves, flanged ends - steel, with full port and stainless steel trim, Class 150.
2. Ball valves, flanged ends - steel, with full port and stainless steel trim, Class 300.
3. Ball valves, flanged ends - iron, Class 125.
4. Ball valves, threaded or flanged ends - stainless steel, two piece with full port; threaded ends.

3.5 DOMESTIC HOT- AND COLD-WATER BALL VALVE SCHEDULE

A. Pipe NPS 2 (DN 50) and Smaller:

1. Ball valves, lead free, threaded ends - brass, one piece.
2. Ball valves, lead free, threaded or soldered ends - brass, two piece with full port and brass trim; threaded ends.
3. Ball valves, lead free, threaded or soldered ends - brass, two piece with full port and stainless steel trim; threaded ends.
4. Ball valves, lead free, threaded or soldered ends - brass, two piece with regular port and brass trim; threaded ends.
5. Ball valves, lead free, threaded or soldered ends - brass, two piece with regular port and stainless steel trim; threaded ends.
6. Ball valves, lead free, threaded or soldered ends - brass, three piece with full port and brass trim; threaded ends.
7. Ball valves, lead free, threaded or soldered ends - brass, three piece with full port and stainless steel trim; threaded ends.
8. Ball valves, lead free, threaded ends - bronze, one piece with bronze trim.
9. Ball valves, lead free, threaded ends - bronze, one piece with stainless steel trim.
10. Ball valves, lead free, threaded or soldered ends - bronze, two piece with full port and bronze or brass trim; threaded ends.
11. Ball valves, lead free, threaded or soldered ends - bronze, two piece with full port and stainless steel trim; threaded ends.
12. Ball valves, lead free, threaded ends - bronze, two piece with regular port and bronze or brass trim.

13. Ball valves, lead free, threaded ends - bronze, two piece with regular port and stainless steel trim.
14. Ball valves, lead free, threaded ends - bronze, three piece with full port and bronze or brass trim.
15. Ball valves, lead free, threaded ends - bronze, three piece with full port and stainless steel trim.
16. Ball valves, lead free, threaded or soldered ends - bronze, three piece with regular port and bronze or brass trim; threaded ends.
17. Ball valves, lead free, threaded or soldered ends - bronze, three piece with regular port and stainless steel trim; threaded ends.
18. Ball valves, lead free, threaded or flanged ends - stainless steel, two piece with full port; threaded ends.
19. Ball valves, lead free, press ends - brass, two piece with full port and brass trim.
20. Ball valves, lead free, press ends - brass, two piece with full port and stainless steel trim.
21. Ball valves, lead free, press ends - bronze, two piece with full port and bronze or brass trim.
22. Ball valves, lead free, press ends - stainless steel, two piece with full port.
23. Ball valves, lead free, flanged or threaded ends - steel, with full port, Class 150; threaded ends.

B. Pipe NPS 2-1/2 (DN 65) and Larger:

1. Ball valves, lead free, flanged or threaded ends - iron, Class 125; flanged ends.
2. Ball valves, lead free, flanged or threaded ends - steel, with full port, Class 150; flanged ends.
3. Ball valves, lead free, flanged or threaded ends - steel, with regular port, Class 150; flanged ends.
4. Ball valves, threaded or flanged ends - stainless steel, two piece with full port; threaded ends.

C. For CPVC Pipe:

1. CPVC Union-Type Ball Check Valve: NPS 2 and smaller at 73 deg F.

    a. End Connections for Valves NPS 2 (DN 50) and Smaller: Socket or.
    b. End Connections for Valves NPS 2-1/2 to NPS 4 (DN 65 to DN 100): Socket or threaded.

D. For PVC Pipe:

1. PVC Union-Type Ball Check Valve: NPS 2 and smaller at 73 deg F.

    a. End Connections for Valves NPS 2 (DN 50) and Smaller: Socket or threaded.
    b. End Connections for Valves NPS 2-1/2 to NPS 4 (DN 65 to DN 100): Socket or threaded.

3.6 LOW-PRESSURE, COMPRESSED-AIR BUTTERFLY VALVE SCHEDULE - 150 PSIG (1035 kPa) OR LESS

A. Pipe NPS 2-1/2 (DN 65) and Larger:

1. Butterfly valves, single flange (lug type) - iron, with aluminum-bronze disc; 150 CWP, NBR seat.
2. Butterfly valves, single flange (lug type) - iron, with ductile-iron disc; 150 CWP, NBR seat.
3. Butterfly valves, single flange (lug type) - iron, with stainless steel disc; 150 CWP, NBR seat.
4. Butterfly valves, flangeless (wafer type) - iron, with aluminum-bronze disc; 150 CWP, NBR seat.
5. Butterfly valves, flangeless (wafer type) - iron, with ductile-iron disc; 150 CWP, NBR seat.
6. Butterfly valves, flangeless (wafer type) - iron, with stainless steel disc; 150 CWP, NBR seat.
7. Butterfly valves, grooved end - ductile iron, 175 CWP; NBR seat.
8. Butterfly valves, grooved end - ductile iron, 300 CWP; NBR seat.
9. Butterfly valves, grooved end - stainless steel; NBR seat.

3.7 HIGH-PRESSURE, COMPRESSED-AIR BUTTERFLY VALVE SCHEDULE - 150 TO 200 PSIG (1035 TO 1380 kPa)

A. Pipe NPS 2-1/2 (DN 65) and Larger:

1. Butterfly valves, single flange (lug type) - iron, with aluminum-bronze disc; 200 CWP, NBR seat.
2. Butterfly valves, single flange (lug type) - iron, with ductile-iron disc; 200 CWP, NBR seat.
3. Butterfly valves, single flange (lug type) - iron, with stainless steel disc; 200 CWP, NBR seat.
4. Butterfly valves, flangeless (wafer type) - iron, with aluminum-bronze disc; 200 CWP, NBR seat.
5. Butterfly valves, flangeless (wafer type) - iron, with ductile-iron disc; 200 CWP, NBR seat.
6. Butterfly valves, flangeless (wafer type) - iron, with stainless steel disc; 200 CWP, NBR seat.
7. Butterfly valves, grooved end - ductile iron, 175 CWP; NBR seat.
8. Butterfly valves, grooved end - ductile iron, 300 CWP; NBR seat.
9. Butterfly valves, grooved end - stainless steel; NBR seat.

3.8 DOMESTIC HOT- AND COLD-WATER BUTTERFLY VALVE SCHEDULE

A. Pipe NPS 2-1/2 (DN 65) and Larger:

1. Butterfly valves, lead free, single flange (lug type) - iron, with aluminum-bronze disc; 150 CWP, EPDM seat.
2. Butterfly valves, lead free, single flange (lug type) - iron, with ductile-iron disc;

150 CWP, EPDM seat.
3. Butterfly valves, lead free, single flange (lug type) - iron, with stainless steel disc; 150 CWP, EPDM seat.
4. Butterfly valves, lead free, flangeless (wafer type) - iron, with aluminum-bronze disc; 150 CWP, EPDM seat.
5. Butterfly valves, lead free, flangeless (wafer type) - iron, with ductile-iron disc; 150 CWP, EPDM seat.
6. Butterfly valves, lead free, flangeless (wafer type) - iron, with stainless steel disc; 150 CWP, EPDM seat.
7. Butterfly valves, lead free, grooved end - ductile iron, 175 CWP; EPDM seat.
8. Butterfly valves, lead free, grooved end - ductile iron, 300 CWP; EPDM seat.

B. For CPVC Pipe: CPVC butterfly valve for NPS 2-1/2 and larger.

C. For PVC Pipe: PVC butterfly valve for NPS 2-1/2 and larger.

D. For Stainless Steel Pipe: Stainless steel, grooved-end butterfly valve for **NPS 2-1/2** and larger.

3.9 LOW-PRESSURE, COMPRESSED-AIR CHECK VALVE SCHEDULE - 150 PSIG (1035 kPa) OR LESS

A. Pipe NPS 2 (DN 50) and Smaller:

1. Vertical, Upflow Applications Only:

   a. Check valves, lift type, threaded or soldered ends - bronze, with bronze disc, Class 125; threaded ends.
   b. Check valves, lift type, threaded or soldered ends - bronze, with nonmetallic disc, Class 125; threaded ends.

2. Horizontal and Vertical Applications:

   a. Check valves, swing type, threaded or soldered ends - bronze, with bronze disc, Class 125; threaded ends.
   b. Check valves, swing type, threaded or soldered ends - bronze, with nonmetallic disc, Class 125; threaded ends.
   c. Check valves, swing type, threaded or soldered ends - bronze, with bronze disc, Class 150; threaded ends.
   d. Check valves, swing type, threaded or soldered ends - bronze, with nonmetallic disc, Class 150; threaded ends.

B. Pipe NPS 2-1/2 (DN 65) and Larger:

1. Check valves, swing type, flanged ends - iron, with metal seats, Class 125.
2. Check valves, swing type, flanged ends - iron, with nonmetallic-to-metal seats, Class 125.
3. Check valves, swing type, flanged ends - iron, with metal seats, Class 250.
4. Check valves, swing type, grooved ends - iron, 300 CWP.
5. Check valves, dual-plate type - iron, with metal seat, Class 125.

6. Check valves, dual-plate type - iron, with metal seat, Class 150.
7. Check valves, dual-plate type - iron, with metal seat, Class 250.
8. Check valves, dual-plate type - iron, with metal seat, Class 300.
9. Check valves, dual-plate type - iron, with resilient seat, Class 125.
10. Check valves, dual-plate type - iron, with resilient seat, Class 150.
11. Check valves, dual-plate type - iron, with resilient seat, Class 250.
12. Check valves, dual-plate type - iron, with resilient seat, Class 300.
13. Check valves, single-plate type - iron, with resilient seat, Class 125; NBR seat.
14. Check valves, single-plate type - iron, with resilient seat, Class 250; NBR seat.

3.10 HIGH-PRESSURE, COMPRESSED-AIR CHECK VALVE SCHEDULE - 150 TO 200 PSIG (1035 TO 1380 kPa)

A. Pipe NPS 2 (DN 50) and Smaller:

1. Vertical, Upflow Applications Only:

    a. Check valves, lift type, threaded or soldered ends - bronze, with bronze disc, Class 125; threaded ends.
    b. Check valves, lift type, threaded or soldered ends - bronze, with nonmetallic disc, Class 125; threaded ends.

2. Horizontal and Vertical Applications:

    a. Check valves, swing type, threaded or soldered ends - bronze, with bronze disc, Class 125; threaded ends.
    b. Check valves, swing type, threaded or soldered ends - bronze, with nonmetallic disc, Class 125; threaded ends.
    c. Check valves, swing type, threaded or soldered ends - bronze, with bronze disc, Class 150; threaded ends.
    d. Check valves, swing type, threaded or soldered ends - bronze, with nonmetallic disc, Class 150; threaded ends.

B. Pipe NPS 2-1/2 (DN 65) and Larger:

1. Check valves, swing type, flanged ends - iron, with metal seats, Class 125.
2. Check valves, swing type, flanged ends - iron, with nonmetallic-to-metal seats, Class 125.
3. Check valves, swing type, flanged ends - iron, with metal seats, Class 250.
4. Check valves, swing type, grooved ends - iron, 300 CWP.
5. Check valves, dual-plate type - iron, with metal seat, Class 125.
6. Check valves, dual-plate type - iron, with metal seat, Class 150.
7. Check valves, dual-plate type - iron, with metal seat, Class 250.
8. Check valves, dual-plate type - iron, with metal seat, Class 300.
9. Check valves, dual-plate type - iron, with resilient seat, Class 125.
10. Check valves, dual-plate type - iron, with resilient seat, Class 150.
11. Check valves, dual-plate type - iron, with resilient seat, Class 250.
12. Check valves, dual-plate type - iron, with resilient seat, Class 300.
13. Check valves, single-plate type - iron, with resilient seat, Class 125; NBR seat.
14. Check valves, single-plate type - iron, with resilient seat, Class 250; NBR seat.

3.11 DOMESTIC HOT- AND COLD-WATER CHECK VALVE SCHEDULE

A. Pipe NPS 2 (DN 50) and Smaller:

1. Check valves, lead free, swing type, threaded or soldered ends - bronze, with bronze disc, Class 125; threaded ends.
2. Check valves, lead free, swing type, threaded or soldered ends - bronze, with nonmetallic disc, Class 125; threaded ends.
3. Check valves, lead free, swing type, threaded or soldered ends - bronze, with bronze disc, Class 150; threaded ends.
4. Check valves, lead free, swing type, threaded or soldered ends - bronze, with nonmetallic disc, Class 150; threaded ends.
5. Check valves, lead free, swing type, press ends - bronze.

B. Pipe NPS 2-1/2 (DN 65) and Larger:

1. Check valves, lead free, swing type, flanged or threaded ends - iron, with metal seats, Class 125; flanged ends.
2. Check valves, lead free, swing type, flanged or threaded ends - iron, with nonmetallic-to-metal Seats, Class 125; flanged ends.
3. Check valves, lead free, swing type, flanged or threaded ends - iron, with metal seats, Class 250; flanged ends.
4. Check valves, lead free, swing type, flanged or threaded ends - iron, with lever- and spring-closure control, Class 125; flanged ends.
5. Check valves, lead free, swing type, flanged or threaded ends - iron, with lever- and weight-closure control, Class 125; flanged ends.
6. Check valves, lead free, swing type, grooved ends - iron, 300 CWP.
7. Check valves, lead free, center guided - iron, compact wafer, with metal seat, Class 125.
8. Check valves, lead free, center guided - iron, globe, with metal seat, Class 125.
9. Check valves, lead free, center guided - iron, compact wafer, with metal seat, Class 150.
10. Check valves, lead free, center guided - iron, globe, with metal seat, Class 150.
11. Check valves, lead free, center guided - iron, compact wafer, with metal seat, Class 250.
12. Check valves, lead free, center guided - iron, globe, with metal seat, Class 250.
13. Check valves, lead free, center guided - iron, compact wafer, with metal seat, Class 300.
14. Check valves, lead free, center guided - iron, globe, with metal seat, Class 300.
15. Check valves, lead free, center guided - iron, compact wafer, with resilient seat, Class 125; EPDM or NBR seat.
16. Check valves, lead free, center guided - iron, globe, with resilient seat, Class 125; EPDM or NBR seat.
17. Check valves, lead free, center guided - iron, compact wafer, with resilient seat, Class 150; EPDM or NBR seat.
18. Check valves, lead free, center guided - iron, globe, with resilient seat, Class 150; EPDM or NBR seat.
19. Check valves, lead free, center guided - iron, compact wafer, with resilient seat, Class 250; EPDM orNBR seat.
20. Check valves, lead free, center guided - iron, globe, with resilient seat, Class 250; EPDM or seat.

21. Check valves, lead free, center guided - iron, compact wafer, with resilient seat, Class 300; EPDM or NBR seat.
22. Check valves, lead free, center guided - iron, globe, with resilient seat, Class 300; EPDM or NBR seat.
23. Check valves, lead free, dual-plate type - iron, with metal seat, Class 125.
24. Check valves, lead free, dual-plate type - iron, with metal seat, Class 150.
25. Check valves, lead free, dual-plate type - iron, with metal seat, Class 250.
26. Check valves, lead free, dual-plate type - iron, with metal seat, Class 300.
27. Check valves, lead free, single-plate type - iron, with resilient seat, Class 125; EPDM or NBR seat.
28. Check valves, lead free, dual-plate type - iron, with resilient seat, Class 125; EPDM or seat.
29. Check valves, lead free, dual-plate type - iron, with resilient seat, Class 150; EPDM or NBR seat.
30. Check valves, lead free, single-plate type - iron, with resilient seat, Class 250; EPDM or NBR seat.
31. Check valves, lead free, dual-plate type - iron, with resilient seat, Class 250; EPDM or NBR seat.
32. Check valves, lead free, dual-plate type - iron, with resilient seat, Class 300; EPDM or NBR seat.

C. For CPVC Pipe:

1. NPS 2 (DN 50) and Smaller: Union ball valve.
2. NPS 4 (DN 100) and Smaller: Union ball valve.

D. For PVC Pipe:

1. NPS 2 (DN 50) and Smaller: Union ball valve.
2. NPS 4 (DN 100) and Smaller: Union ball valve.

3.12 PUMP-DISCHARGE CHECK VALVE SCHEDULE

A. Pipe NPS 2 (DN 50) and Smaller:

1. Check valves, lead free, swing type, threaded or soldered ends - bronze, with bronze disc, Class 125; threaded ends.
2. Check valves, lead free, swing type, threaded or soldered ends - bronze, with nonmetallic disc, Class 125; threaded ends.
3. Check valves, lead free, swing type, threaded or soldered ends - bronze, with bronze disc, Class 150; threaded ends.
4. Check valves, lead free, swing type, threaded or soldered ends - bronze, with nonmetallic disc, Class 150; threaded ends.

B. Pipe NPS 2-1/2 (DN 65) and Larger for Domestic Water Pumps:

1. Check valves, lead free, swing type, flanged or threaded ends - iron, with lever- and spring-closure control, Class 125; flanged ends.
2. Check valves, lead free, swing type, flanged or threaded ends - iron, with lever- and weight-closure control, Class 125; flanged ends.

3. Check valves, lead free, center guided - iron, compact wafer, with metal seat, Class 125.
4. Check valves, lead free, center guided - iron, globe, with metal seat, Class 125.
5. Check valves, lead free, center guided - iron, compact wafer, with metal seat, Class 150.
6. Check valves, lead free, center guided - iron, globe, with metal seat, Class 150.
7. Check valves, lead free, center guided - iron, compact wafer, with metal seat, Class 250.
8. Check valves, lead free, center guided - iron, globe, with metal seat, Class 250.
9. Check valves, lead free, center guided - iron, compact wafer, with metal seat, Class 300.
10. Check valves, lead free, center guided - iron, globe, with metal seat, Class 300.
11. Check valves, lead free, center guided - iron, compact wafer, with resilient seat, Class 125; EPDM or NBR seat.
12. Check valves, lead free, center guided - iron, globe, with resilient seat, Class 125; EPDM or NBR seat.
13. Check valves, lead free, center guided - iron, compact wafer, with resilient seat, Class 150; EPDM or NBR seat.
14. Check valves, lead free, center guided - iron, globe, with resilient seat, Class 150; EPDM or NBR seat.
15. Check valves, lead free, center guided - iron, compact wafer, with resilient seat, Class 250; EPDM or NBR seat.
16. Check valves, lead free, center guided - iron, globe, with resilient seat, Class 250; EPDM or NBR seat.
17. Check valves, lead free, center guided - iron, compact wafer, with resilient seat, Class 300; EPDM or NBR seat.
18. Check valves, lead free, center guided - iron, globe, with resilient seat, Class 300; EPDM or NBR seat.

C. Pipe NPS 2-1/2 (DN 65) and Larger for Sanitary Waste and Storm Drainage:

1. Check valves, swing type, flanged ends - iron, with lever- and spring-closure control, Class 125.
2. Check valves, swing type, flanged ends - iron, with lever- and weight-closure control, Class 125.

3.13 LOW-PRESSURE, COMPRESSED-AIR GATE VALVE SCHEDULE - 150 PSIG (1035 kPa) OR LESS

A. Pipe NPS 2 (DN 50) and Smaller:

1. Gate valves, threaded or soldered ends - bronze, NRS, Class 125; threaded ends.
2. Gate valves, threaded or soldered ends - bronze, RS, Class 125; threaded ends.
3. Gate valves, threaded ends - bronze, NRS, Class 150.
4. Gate valves, threaded ends - bronze, RS, Class 150.

B. Pipe NPS 2-1/2 (DN 65) and Larger:

1. Gate valves, flanged ends - iron, NRS, Class 125.

2. Gate valves, flanged ends - iron, OS&Y, Class 125.
3. Gate valves, flanged ends - iron, NRS, Class 250.
4. Gate valves, flanged ends - iron, OS&Y, Class 250.

3.14 HIGH-PRESSURE, COMPRESSED-AIR GATE VALVE SCHEDULE - 150 TO 200 PSIG (1035 TO 1380 kPa)

A. Pipe NPS 2 (DN 50) and Smaller:

1. Gate valves, threaded or soldered ends - bronze, NRS, Class 125; threaded or soldered ends.
2. Gate valves, threaded or soldered ends - bronze, RS, Class 125; threaded or soldered ends.
3. Gate valves, threaded ends - bronze, NRS, Class 150.
4. Gate valves, threaded ends - bronze, RS, Class 150.

B. Pipe NPS 2-1/2 (DN 65) and Larger:

1. Gate valves, flanged ends - iron, NRS, Class 125.
2. Gate valves, flanged ends - iron, OS&Y, Class 125.
3. Gate valves, flanged ends - iron, NRS, Class 250.
4. Gate valves, flanged ends - iron, OS&Y, Class 250.

3.15 DOMESTIC HOT- AND COLD-WATER GATE VALVE SCHEDULE

A. Pipe NPS 2 (DN 50) and Smaller:

1. Gate valves, lead free, threaded or soldered ends - bronze, NRS, Class 125; threaded or soldered ends.
2. Gate valves, lead free, threaded or soldered ends - bronze, RS, Class 125; threaded or soldered ends.
3. Gate valves, lead free, threaded ends - bronze, NRS, Class 150.
4. Gate valves, lead free, threaded ends - bronze, RS, Class 150.
5. Gate valves, lead free, press ends - bronze.

B. Pipe NPS 2-1/2 (DN 65) and Larger:

1. Gate valves, lead free, flanged ends - iron, NRS, Class 125.
2. Gate valves, lead free, flanged ends - iron, OS&Y, Class 125.
3. Gate valves, lead free, flanged ends - iron, NRS, Class 250.
4. Gate valves, lead free, flanged ends - iron, OS&Y, Class 250.

C. For CPVC Pipe:

1. NPS 2 (DN 50) and Smaller: Union gate valve.
2. NPS 4 (DN 100) and Smaller: Union gate valve.

D. For PVC Pipe:

1. NPS 2 (DN 50) and Smaller: Union gate valve.

2. NPS 4 (DN 100) and Smaller: Union gate valve.

END OF SECTION 22 05 23

SECTION 22 05 29 - HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Pipe hangers and supports - metal.
2. Pipe hangers - metal, trapeze type.
3. Pipe hangers - FRP.
4. Strut support system - metal, rod type.
5. Strut support systems - FRP.
6. Thermal hanger shield inserts.
7. Fastener systems.
8. Pipe-positioning systems.
9. Equipment supports.

B. Related Requirements:

1. Section 055000 "Metal Fabrications" for structural-steel shapes and plates for trapeze hangers for pipe and equipment supports.
2. Section 220500 "Common Work Results for Plumbing" for pipe guides and anchors.
3. Section 220548.13 "Vibration Controls for Plumbing Piping and Equipment" for vibration isolation devices.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: Signed and sealed by a qualified professional engineer. Show fabrication and installation details and include calculations for the following:

1. Trapeze pipe hangers.
2. Metal strut support systems.
3. Rooftop-mounted strut support systems.
4. FRP strut support systems.
5. Pipe stands.
6. Equipment supports.

C. Delegated Design Submittals: For trapeze hangers and strut support systems indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1. Detail fabrication/assembly and design calculations for strut support systems.

2. Detail fabrication/assembly and design calculations for each type of strut support system, by the manufacturer's technical representative.

D. Sustainable Design Submittals:

1.3 INFORMATIONAL SUBMITTALS

A. Welding certificates.

1.4 QUALITY ASSURANCE

A. Structural-Steel Welding Qualifications: Qualify procedures and personnel in accordance with AWS D1.1/D1.1M.

B. Pipe Welding Qualifications: Qualify procedures and operators in accordance with 2021 ASME Boiler and Pressure Vessel Code, Section IX.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design trapeze hangers , strut support systems, and equipment supports.

B. Structural Performance: Hangers and supports for plumbing piping and equipment are to withstand the effects of gravity loads and stresses within limits and under conditions indicated in accordance with ICC requirements.

1. Design supports for multiple pipes, including pipe stands, capable of supporting combined weight of supported systems, system contents, and test water.
2. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.
3. Design seismic-restraint hangers and supports for piping and equipment and obtain approval from authorities having jurisdiction.

2.2 PIPE HANGERS AND SUPPORTS - METAL

A. Pipe Hangers and Supports - Carbon Steel:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Anvil; an ASC Engineered Solution
b. Cooper B-line; brand of Eaton, Electrical Sector
c. FNW; Ferguson Enterprises, Inc.

2. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.
3. Galvanized Metallic Coatings: Pregalvanized, hot-dip galvanized, or electro-galvanized.
4. Nonmetallic Coatings: Plastic coated or epoxy powder coated.
5. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.
6. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel.

B. Pipe/Tube Hangers and Supports - Copper:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

   a. Anvil; an ASC Engineered Solution
   b. Cooper B-line; brand of Eaton, Electrical Sector
   c. FNW; Ferguson Enterprises, Inc.

2. Description: MSS SP-58, Types 1 through 58, copper-plated-steel, factory-fabricated components.
3. Hanger Rods: Continuous-thread rod, nuts, and washer made of copper-plated steel.

2.3 PIPE HANGERS - METAL, TRAPEZE TYPE

A. Description: MSS SP-58, Type 59, shop- or field-fabricated pipe-support assembly, made from structural-carbon-steel shapes, with MSS SP-58 carbon-steel hanger rods, nuts, saddles, and U-bolts.

2.4 PIPE HANGERS - FRP

A. Pipe Hangers - FRP, Clevis Type:

1. Description: Similar to MSS SP-58, Type 1 factory-fabricated steel pipe hanger, except hanger is made of fiberglass-reinforced plastic resin.
2. Hanger Rods: Continuous-thread stainless steel rod, washer, and nuts made of FRP polyurethane or stainless steel.
3. Flammability: ASTM D635, ASTM E84, UL 94.

B. Pipe Hangers - FRP, Strap Type:

1. Description: Similar to MSS SP-58, Type 9 or Type 10 steel pipe hanger, except hanger is made of fiberglass-reinforced plastic resin.

   a. Flammability: ASTM D635, ASTM E84, UL 94.

2. Hanger Rod and Fittings: Continuous-thread rod, washer, and nuts made of stainless steel.

2.5 STRUT SUPPORT SYSTEMS - METAL

A. Strut Support System - Metal, Rod Type:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

    a. ABB Electrification Installations Products
    b. Anvil; an ASC Engineered Solution
    c. Atkore Unistrut
    d. CADDY; brand of nVent Electrical plc
    e. Carpenter & Paterson, Inc
    f. Cooper B-line; brand of Eaton, Electrical Sector
    g. Empire Industries, Inc.
    h. Flex-Strut Inc.
    i. G-Strut
    j. Haydon Corp.
    k. PHD Manufacturing, Inc
    l. Rocket Rack; Robroy Industries
    m. Wesanco/ZSi-Foster; an Ideal Tridon Group Company

2. Description: Factory-fabricated pipe-support assembly, made of steel channels, vertical metal support rods, accessories, fittings, and other components for supporting multiple parallel pipes.
3. Standard: Comply with MFMA-4, factory-fabricated components for field assembly.
4. Struts: Continuous slotted carbon-steel.
5. Strut Width: Selected for applicable load criteria.
6. Strut Nuts: Formed or stamped nuts or other devices designed to fit into channel slot and, when tightened, prevent slipping along channel.
7. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel.
8. Metallic Coating: Plain.
9. Paint Coating: Green epoxy, acrylic, or urethane.
10. Plastic Coating: PVC.

2.6 STRUT SUPPORT SYSTEMS - FRP

A. Strut Support System - FRP:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

    a. Atkore Unistrut
    b. Champion Fiberglass, Inc
    c. G-Strut

2. Description: Structural-grade, factory-formed, glass-fiber-resin channels and angles for supporting multiple parallel pipes.

a. Standard: Comply with MFMA-4, factory-fabricated components for field assembly.
b. Struts: Continuous slotted fiberglass-reinforced plastic channel with inturned lips.
c. Strut Width: Selected for applicable load criteria.
d. Fittings and Accessories: Products provided by channel and angle manufacturer and designed for use with those items.
e. Fitting and Accessory Materials: Same as those for channels and angles , except metal items may be stainless steel.
f. Rated Strength: Selected to suit applicable load criteria.
g. Protect finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

2.7 THERMAL HANGER SHIELD INSERTS

A. Thermal Hanger Shield Inserts:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

   a. Aeroflex USA
   b. Buckaroos, Inc.
   c. Carpenter & Paterson, Inc
   d. KB Enterprise
   e. National Pipe Hanger Corporation
   f. Pipe Shields Inc.
   g. Piping Technology & Products, Inc
   h. Rilco Manufacturing Co., Inc
   i. Value Engineered Products, Inc

2. Insulation-Insert Material for Cold Piping: ASTM C552, Type II cellular glass with 100 psig or ASTM C591, Type VI, Grade 1 polyisocyanurate with 125 psig minimum compressive strength and vapor barrier.
3. Insulation-Insert Material for Hot Piping: Water-repellent-treated, ASTM C533, Type I calcium silicate with 100 psig ASTM C552, Type II cellular glass with 100 psig or ASTM C591, Type VI, Grade 1 polyisocyanurate with 125 psig minimum compressive strength.
4. For Trapeze or Clamped Systems: Insert and shield are to cover entire circumference of pipe.
5. For Clevis or Band Hangers: Insert and shield are to cover bottom 180 degrees of pipe.
6. Insert Length: Extend **2 inches** beyond sheet metal shield for piping operating below ambient air temperature.

2.8 FASTENER SYSTEMS

A. Fastener System - Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete, with pull-out, tension, and shear capacities

required for supported loads and building materials where used.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

    a. Hilti, Inc.
    b. ITW Ramset/Red Head; Illinois Tool Works, Inc.
    c. MKT Fastening, LLC

B. Fastener System - Mechanical-Expansion Anchors: Insert-wedge-type anchors, for use in hardened portland cement concrete, with pull-out, tension, and shear capacities required for supported loads and building materials where used.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

    a. Cooper B-line; brand of Eaton, Electrical Sector
    b. Empire Industries, Inc.
    c. Hilti, Inc.
    d. ITW Ramset/Red Head; Illinois Tool Works, Inc.
    e. MKT Fastening, LLC

2. Indoor Applications: Zinc-plated or stainless steel.
3. Outdoor Applications: Stainless steel.

2.9 PIPE-POSITIONING SYSTEMS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Holdrite; a division of Reliance Worldwide Corporation

B. Description: IAPMO PS 42 positioning system composed of metal brackets, clips, and straps for positioning piping in pipe spaces; for plumbing fixtures in commercial applications.

2.10 EQUIPMENT SUPPORTS

A. Description: Welded, shop- or field-fabricated equipment support made from structural-carbon-steel shapes.

2.11 MATERIALS

A. Aluminum: **ASTM B221**.

B. Carbon Steel: ASTM A1011/A1011M.

C. Structural Steel: ASTM A36/A36M carbon-steel plates, shapes, and bars; black and galvanized.

D. Stainless Steel: ASTM A240/A240M.

E. Grout: ASTM C1107/C1107M, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink and nonmetallic grout; suitable for interior and exterior applications.

1. Properties: Nonstaining, noncorrosive, and nongaseous.
2. Design Mix: **5000 psi**, 28-day compressive strength.

PART 3 - EXECUTION

3.1 APPLICATION

A. Comply with requirements in Section 078413 "Penetration Firestopping" for firestopping materials and installation, for penetrations through fire-rated walls, ceilings, and assemblies.

B. Strength of Support Assemblies: Where not indicated, select sizes of components, so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination is to include weight of supported components plus 200 lb.

3.2 INSTALLATION OF HANGERS AND SUPPORTS

A. Install hangers and supports to allow controlled thermal and seismic movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.

B. Install lateral bracing with pipe hangers and supports to prevent swaying.

C. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, NPS 2-1/2 and larger and at changes in direction of piping. Coordinate location of concrete inserts before concrete is placed.

D. Load Distribution: Install hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.

E. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and to not exceed maximum pipe deflections allowed by ASME B31.9 for building services piping.

F. Insulated Piping:

1. Attach clamps and spacers to piping.

a. Piping Operating above Ambient Air Temperature: Clamp may project through insulation.

b. Piping Operating below Ambient Air Temperature: Use thermal hanger shield insert with clamp sized to match OD of insert.
c. Do not exceed pipe stress limits allowed by ASME B31.9 for building services piping.

2. Install MSS SP-58, Type 39, protection saddles if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.

a. Thermal hanger shield inserts may be used as an option. Include steel weight-distribution plate for pipe **NPS 4** and larger if pipe is installed on rollers.

3. Install MSS SP-58, Type 40, protective shields on cold piping with vapor barrier. Shields are to span an arc of 180 degrees.

a. Thermal hanger shield inserts may be used as an option. Include steel weight-distribution plate for pipe **NPS 4** and larger if pipe is installed on rollers.

4. Shield Dimensions for Pipe: Not less than the following:

a. NPS 1/4 to NPS 3-1/2 (DN 8 to DN 90): **12 inches** long and **0.048 inch** thick.
b. NPS 4 (DN 100): **12 inches** long and **0.06 inch** thick.
c. NPS 5 and NPS 6 (DN 125 and DN 150): **18 inches** long and **0.06 inch** thick.
d. NPS 8 to NPS 14 (DN 200 to DN 350): **24 inches** long and **0.075 inch** thick.
e. NPS 16 to NPS 24 (DN 400 to DN 600): **24 inches** long and **0.105 inch** thick.

5. Pipes NPS 8 (DN 200) and Larger: Include wood or reinforced calcium-silicate-insulation inserts of length at least as long as protective shield.

G. Metal Pipe-Hanger Installation: Comply with MSS SP-58. Install hangers, supports, clamps, and attachments as required to properly support piping from building structure.

H. Metal Trapeze Pipe-Hanger Installation: Comply with MSS SP-58. Arrange for grouping of parallel runs of horizontal piping, and support together on field-fabricated trapeze pipe hangers.

1. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size, or install intermediate supports for smaller-diameter pipes as specified for individual pipe hangers.
2. Field fabricate in accordance with ASTM A36/A36M carbon-steel shapes selected for loads being supported. Weld steel in accordance with AWS D1.1/D1.1M.

I. FRP Pipe-Hanger Installation: Comply with applicable portions of MSS SP-58. Install hangers and attachments as required to properly support piping from building structure.

J. Strut System Installation: Metal, rod type; arrange for grouping of parallel runs of piping, and support together on field-assembled strut systems. Install in accordance with manufacturer's written installation instructions.

K. Thermal Hanger Shield Installation: Install in pipe hanger or shield for insulated piping.

L. Fastener System Installation:

1. Install powder-actuated fasteners for use in lightweight concrete or concrete slabs less than **4 inches** thick after concrete is placed and cured. Use installers that are licensed by powder-actuated tool manufacturer.
2. Install mechanical-expansion anchors in concrete after concrete is placed and completely cured. Install fasteners in accordance with manufacturer's written instructions.
3. Install lag screw wood fasteners in accordance with manufacturer's written instructions.
4. Install fasteners in accordance with manufacturer's written instructions.

M. Pipe Stand Installation:

1. Pipe Stand Types, except Curb-Mounted Type: Assemble components and mount on smooth roof surface. Do not penetrate roof membrane.
2. Curb-Mounted-Type Pipe Stands: Assemble components or fabricate pipe stand and mount on permanent, stationary roof curb. See Section 077200 "Roof Accessories" for curbs.

N. Pipe-Positioning-System Installation: Install support devices to make rigid supply and waste piping connections to each plumbing fixture.

O. Install hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.

P. Equipment Support Installation:

1. Fabricate from welded-structural-steel shapes.
2. Fabricate structural-steel stands to suspend equipment from structure overhead or to support equipment above floor.
3. Grouting: Place grout under supports for floor-mounted equipment, and make bearing surface smooth.
4. Provide lateral bracing, to prevent swaying.

3.3 METAL FABRICATIONS

A. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers and equipment supports.

B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded.

C. Field Welding: Comply with AWS D1.1/D1.1M procedures for shielded, metal arc

welding; appearance and quality of welds; and methods used in correcting welding work; and with the following:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove welding flux immediately.
4. Finish welds at exposed connections, so no roughness shows after finishing and so contours of welded surfaces match adjacent contours.

3.4 ADJUSTING

A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.

B. Trim excess length of continuous-thread hanger and support rods to 1-1/2 inches.

3.5 PAINTING

A. Touchup:

1. Clean field welds and abraded, shop-painted areas. Paint exposed areas immediately after erecting hangers and supports. Use same materials as those used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.

    a. Apply paint by brush or spray to provide a minimum dry film thickness of **2.0 mils**.

2. Comply with requirements in Section 099113 "Exterior Painting" for cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal.
3. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas, and apply galvanizing-repair paint to comply with ASTM A780/A780M.

3.6 HANGER AND SUPPORT SCHEDULE

A. Specific hanger and support requirements are in Sections specifying piping systems and equipment.

B. Comply with MSS SP-58 for pipe-hanger selections and applications that are not specified in piping system Sections.

C. Use hangers and supports with galvanized metallic coatings for piping and equipment that will not have field-applied finishes.

D. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.

E. Use carbon-steel pipe hangers and supports metal trapeze pipe hangers and metal framing systems and attachments for general service applications.

F. Use stainless steel pipe hangers and and stainless steel or corrosion-resistant attachments for hostile environment applications.

G. Use copper-plated pipe hangers and copper or stainless steel attachments for copper piping and tubing.

H. Use padded hangers for piping that is subject to scratching.

I. Use thermal hanger shield inserts for insulated piping and tubing.

J. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of noninsulated or insulated, stationary pipes **NPS 1/2 to NPS 30**.
2. Yoke-Type Pipe Clamps (MSS Type 2): For suspension of up to **1050 deg F** pipes **NPS 4 to NPS 24**, requiring up to **4 inches** of insulation.
3. Carbon- or Alloy-Steel, Double-Bolt Pipe Clamps (MSS Type 3): For suspension of pipes **NPS 3/4 to NPS 36**, requiring clamp flexibility and up to **4 inches** of insulation.
4. Steel Pipe Clamps (MSS Type 4): For suspension of cold and hot pipes **NPS 1/2 to NPS 24** if little or no insulation is required.
5. Pipe Hangers (MSS Type 5): For suspension of pipes **NPS 1/2 to NPS 4**, to allow off-center closure for hanger installation before pipe erection.
6. Adjustable, Swivel Split- or Solid-Ring Hangers (MSS Type 6): For suspension of noninsulated, stationary pipes **NPS 3/4 to NPS 8**.
7. Adjustable, Steel Band Hangers (MSS Type 7): For suspension of noninsulated, stationary pipes **NPS 1/2 to NPS 8**.
8. Adjustable Band Hangers (MSS Type 9): For suspension of noninsulated, stationary pipes **NPS 1/2 to NPS 8**.
9. Adjustable, Swivel-Ring Band Hangers (MSS Type 10): For suspension of noninsulated, stationary pipes **NPS 1/2 to NPS 8**.
10. Split Pipe Ring with or without Turnbuckle Hangers (MSS Type 11): For suspension of noninsulated, stationary pipes **NPS 3/8 to NPS 8**.
11. Extension Hinged or Two-Bolt Split Pipe Clamps (MSS Type 12): For suspension of noninsulated, stationary pipes **NPS 3/8 to NPS 3**.
12. U-Bolts (MSS Type 24): For support of heavy pipes **NPS 1/2 to NPS 30**.
13. Clips (MSS Type 26): For support of insulated pipes not subject to expansion or contraction.
14. Pipe Saddle Supports (MSS Type 36): For support of pipes **NPS 4 to NPS 36**, with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate.
15. Pipe Stanchion Saddles (MSS Type 37): For support of pipes **NPS 4 to NPS 36**, with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate, and with U-bolt to retain pipe.
16. Adjustable Pipe Saddle Supports (MSS Type 38): For stanchion-type support for pipes **NPS 2-1/2 to NPS 36** if vertical adjustment is required, with steel-pipe base stanchion support and cast-iron floor flange.

17. Single-Pipe Rolls (MSS Type 41): For suspension of pipes **NPS 1 to NPS 30**, from two rods if longitudinal movement caused by expansion and contraction occurs.
18. Adjustable Roller Hangers (MSS Type 43): For suspension of pipes **NPS 2-1/2 to NPS 24**, from single rod if horizontal movement caused by expansion and contraction occurs.
19. Complete Pipe Rolls (MSS Type 44): For support of pipes **NPS 2 to NPS 42** if longitudinal movement caused by expansion and contraction occurs but vertical adjustment is unnecessary.
20. Pipe Roll and Plate Units (MSS Type 45): For support of pipes **NPS 2 to NPS 24** if small horizontal movement caused by expansion and contraction occurs and vertical adjustment is unnecessary.
21. Adjustable Pipe Roll and Base Units (MSS Type 46): For support of pipes **NPS 2 to NPS 30** if vertical and lateral adjustment during installation, in addition to expansion and contraction, is required.

K. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers **NPS 3/4 to NPS 24**.
2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers **NPS 3/4 to NPS 24** if longer ends are required for riser clamps.

L. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Steel Turnbuckles (MSS Type 13): For adjustment of up to **6 inches** for heavy loads.
2. Steel Clevises (MSS Type 14): For **120 to 450 deg F** piping installations.
3. Swivel Turnbuckles (MSS Type 15): For use with MSS Type 11 split pipe rings.
4. Malleable-Iron Sockets (MSS Type 16): For attaching hanger rods to various types of building attachments.
5. Steel Weldless Eye Nuts (MSS Type 17): For **120 to 450 deg F** piping installations.

M. Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Steel or Malleable-Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete ceiling.
2. Top-Beam C-Clamps (MSS Type 19): For use under roof installations with bar-joist construction, to attach to top flange of structural shape.
3. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles.
4. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.
5. Welded Beam Attachments (MSS Type 22): For attaching to bottom of beams if loads are considerable and rod sizes are large.
6. C-Clamps (MSS Type 23): For structural shapes.
7. Top-Beam Clamps (MSS Type 25): For top of beams if hanger rod is required

tangent to flange edge.

8. Side-Beam Clamps (MSS Type 27): For bottom of steel I-beams.
9. Steel-Beam Clamps with Eye Nuts (MSS Type 28): For attaching to bottom of steel I-beams for heavy loads.
10. Linked-Steel Clamps with Eye Nuts (MSS Type 29): For attaching to bottom of steel I-beams for heavy loads, with link extensions.
11. Malleable-Beam Clamps with Extension Pieces (MSS Type 30): For attaching to structural steel.
12. Welded-Steel Brackets: For support of pipes from below or for suspending from above by using clip and rod. Use one of the following for indicated loads:

    a. Light (MSS Type 31): **750 lb**.
    b. Medium (MSS Type 32): **1500 lb**.
    c. Heavy (MSS Type 33): **3000 lb**.

13. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.
14. Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is required.
15. Horizontal Travelers (MSS Type 58): For supporting piping systems subject to linear horizontal movement where headroom is limited.

N. Saddles and Shields: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Steel-Pipe-Covering Protection Saddles (MSS Type 39): To fill interior voids with insulation that matches adjoining insulation.
2. Protection Shields (MSS Type 40): Of length recommended in writing by manufacturer to prevent crushing insulation.
3. Thermal Hanger Shield Inserts: For supporting insulated pipe.

O. Spring Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Restraint-Control Devices (MSS Type 47): Where indicated to control piping movement.
2. Spring Cushions (MSS Type 48): For light loads if vertical movement does not exceed **1-1/4 inches**.
3. Spring-Cushion Roll Hangers (MSS Type 49): For equipping Type 41 roll hanger with springs.
4. Spring Sway Braces (MSS Type 50): To retard sway, shock, vibration, or thermal expansion in piping systems.
5. Variable-Spring Hangers (MSS Type 51): Preset to indicated load, and limit variability factor to 25 percent to allow expansion and contraction of piping system from hanger.
6. Variable-Spring Base Supports (MSS Type 52): Preset to indicated load, and limit variability factor to 25 percent to allow expansion and contraction of piping system from base support.
7. Variable-Spring Trapeze Hangers (MSS Type 53): Preset to indicated load, and limit variability factor to 25 percent to allow expansion and contraction of piping system from trapeze support.
8. Constant Supports: For critical piping stress and if necessary to avoid transfer of

stress from one support to another support, critical terminal, or connected equipment. Include auxiliary stops for erection, hydrostatic test, and load-adjustment capability. These supports include the following types:

a. Horizontal (MSS Type 54): Mounted horizontally.
b. Vertical (MSS Type 55): Mounted vertically.
c. Trapeze (MSS Type 56): Two vertical-type supports and one trapeze member.

P. Comply with MSS SP-58 for trapeze pipe-hanger selections and applications that are not specified in piping system Sections.

Q. Use powder-actuated fasteners or mechanical-expansion anchors instead of building attachments where required in concrete construction.

R. Use pipe-positioning systems in pipe spaces behind plumbing fixtures to support supply and waste piping for plumbing fixtures.

END OF SECTION 22 05 29

SECTION 22 05 48.13 - VIBRATION CONTROLS FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Elastomeric isolation pads.
2. Restrained elastomeric isolation mounts.
3. Air-spring isolators.
4. Elastomeric hangers.
5. Spring hangers.
6. Snubbers.
7. Restraints - cable type.
8. Post-installed concrete anchors.
9. Concrete inserts.

B. Related Requirements:

1. Section 210548.13 "Vibration Controls for Fire-Suppression Piping and Equipment" for devices for fire-suppression equipment and systems.
2. Section 230548.13 "Vibration Controls for HVAC" for devices for HVAC equipment and systems.

1.2 DEFINITIONS

A. IBC: International Building Code.

B. OSHPD: Office of Statewide Health Planning and Development (for the State of California owned and regulated medical facilities).

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include rated load, rated deflection, and overload capacity for each vibration isolation device.
2. Include load rating for each wind-load-restraint fitting and assembly.
3. Illustrate and indicate style, material, strength, fastening provision, and finish for each type and size of vibration isolation device and wind-load-restraint component.
4. Annotate to indicate application of each product submitted and compliance with requirements.
5. Interlocking Snubbers: Include ratings for horizontal, vertical, and combined loads.

B. Shop Drawings:

1. Detail fabrication and assembly of equipment bases. Detail fabrication including anchorages and attachments to structure and to supported equipment. Include adjustable motor bases, rails, and frames for equipment mounting.
2. Vibration Isolation Base Details: Detail fabrication including anchorages and attachments to structure and to supported equipment. Include adjustable motor bases, rails, and frames for equipment mounting.

C. Delegated-Design Submittal:

1. For each wind-load protection device that is required by this Section or is indicated on Drawings, submit the following:

a. Vibration Isolator and Wind-Load-Restraint Selection: Select vibration isolators and wind-load restraints, and vibration isolation bases complying with performance requirements, design criteria, and analysis data.
b. Riser Supports: Include riser diagrams and calculations showing anticipated expansion and contraction at each support point, initial and final loads on building structure, and spring deflection changes. Include certification by professional engineer that riser system was examined for excessive stress and that none exists.
c. Concrete Anchors and Inserts: Include calculations showing anticipated wind loads.
d. Wind-Load Design Calculations: Submit all static and dynamic loading calculations prepared under "Wind-Load Design Calculations" Paragraph in "Performance Requirements" Article.

1) Qualified Professional Engineer: All designated-design submittals for wind-restraint calculations are to be signed and sealed by qualified professional engineer responsible for their preparation.

e. Wind-Restraint Detail Drawings:

1) Design Analysis: To support selection and arrangement of wind restraints. Include calculations of combined tensile and shear loads.
2) Details: Indicate fabrication and arrangement. Detail attachments of restraints to restrained items and to the structure. Show attachment locations, methods, and spacings. Identify components, list their strengths, and indicate directions and values of forces transmitted to the structure during wind events. Indicate association with vibration isolation devices.
3) Coordinate vibration isolation details with wind-restraint details required for equipment mounted outdoors. Comply also with requirements in other Sections for equipment mounted outdoors.

f. All delegated-design submittals for wind-restraint detail Drawings are to be signed and sealed by qualified professional engineer responsible for their preparation.
g. Product Listing, Preapproval, and Evaluation Documentation: By UL, showing maximum ratings of restraint items and basis for approval (tests or

calculations).

2. Design Calculations for Vibration Isolation Devices: Calculate static and dynamic loading due to equipment weight and operating forces required to select proper vibration isolators, and to design vibration isolation bases.
3. Riser Supports: Include riser diagrams and calculations showing anticipated expansion and contraction at each support point, initial and final loads on building structure, and spring deflection changes. Include certification that riser system was examined for excessive stress and that none exists.

1.4 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Show coordination of vibration isolation and wind-load reinforcement device installation for plumbing piping and equipment with other systems and equipment in the vicinity, including other supports and restraints, if any.

B. Qualification Data: For professional engineer.

C. Welding certificates.

D. Air-Spring Mounting System Performance Certification: Include natural frequency, load, and damping test data performed by an independent agency.

E. Field quality-control reports.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For air-spring mounts and restrained-air-spring mounts to include in operation and maintenance manuals.

1.6 QUALITY ASSURANCE

A. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct testing indicated, be an NRTL as defined by OSHA in 29 CFR 1910.7 and be acceptable to authorities having jurisdiction.

B. Welding Qualifications: Qualify procedures and personnel in accordance with AWS D1.1/D1.1M, "Structural Welding Code - Steel."

C. Wind-Load-Restraint Device Load Ratings: Devices to be tested and rated in accordance with applicable code requirements and authorities having jurisdiction. Devices to be listed by a nationally recognized third party that requires periodic follow-up inspections and has a listing directory available to the public. Provide third-party listing by one or more of the following: UL product listing.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design system.

1. Wind-Load Performance: Equipment and systems shall withstand the effects of high wind events determined in accordance with ICC requirements.

B. Wind-Load Design Calculations:

1. Perform calculations to obtain force information necessary to properly select wind-load-restraint devices, fasteners, and anchorage. Perform calculations using methods acceptable to applicable code authorities and as presented in ICC requirements. Where "ASCE/SEI 7" is used throughout this Section, it is to be understood that the edition referred to in this subparagraph is intended as referenced throughout the Section Text unless otherwise noted.

a. Factors indicated below that are specific to individual pieces of equipment must be obtained by Contractor and must be included in individual component submittal packages.
b. Coordinate design wind-load calculations with vibration isolator calculations for equipment requiring both vibration isolation and wind-load reinforcement. Comply with requirements in other Sections in addition to those in this Section for equipment mounted outdoors.

2.2 ELASTOMERIC ISOLATION PADS

A. Elastomeric Isolation Pads: .

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Ace Mountings Co., Inc.
b. CADDY; brand of nVent Electrical plc
c. California Dynamics Corporation
d. Isolation Technology, Inc
e. Kinetics Noise Control, Inc
f. Korfund
g. Mason Industries, Inc.
h. NOVIA; a division of Carpenter & Paterson
i. Vibration Eliminator Co., Inc
j. Vibration Isolation
k. Vibration Management Corp.
l. VMC GROUP

2. Fabrication: Single or multiple layers of sufficient durometer stiffness for uniform

loading over pad area.
3. Size: Factory or field cut to match requirements of supported equipment.
4. Minimum deflection as indicated on Drawings.
5. Pad Material: Oil- and water-resistant rubber.
6. Infused nonwoven cotton or synthetic fibers.
7. Load-bearing metal plates adhered to pads.
8. Sandwich-Core Material: Resilient and elastomeric.

    a. Infused nonwoven cotton or synthetic fibers.

2.3 RESTRAINED ELASTOMERIC ISOLATION MOUNTS

A. Restrained Elastomeric Isolation Mounts: .

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

    a. Ace Mountings Co., Inc.
    b. CADDY; brand of nVent Electrical plc
    c. California Dynamics Corporation
    d. Isolation Technology, Inc
    e. Kinetics Noise Control, Inc
    f. Korfund
    g. Mason Industries, Inc.
    h. NOVIA; a division of Carpenter & Paterson
    i. Vibration Eliminator Co., Inc
    j. Vibration Isolation
    k. Vibration Management Corp.
    l. VMC GROUP

2. Description: All-directional isolator with restraints containing two separate and opposing elastomeric elements that prevent central threaded element and attachment hardware from contacting the housing during normal operation.

    a. Housing: Cast-ductile iron or welded steel.
    b. Elastomeric Material: Molded, oil-resistant rubber, neoprene, or other elastomeric material.

3. Minimum deflection as indicated on Drawings.

2.4 AIR-SPRING ISOLATORS

A. Freestanding, Single or Multiple, Compressed-Air Bellows: .

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. CADDY; brand of nVent Electrical plc
b. Firestone Industrial Products Company
c. Mason Industries, Inc.
d. Vibration Management Corp.

2. Bellows Assembly: Upper and lower powder-coated steel sections connected by a replaceable, flexible, nylon-reinforced neoprene bellows or similar elastomeric material.
3. Maximum Natural Frequency: 3 Hz.
4. Operating Pressure Range: **25 to 100 psi**.
5. Burst Pressure: At least three times manufacturer's published maximum operating pressure.
6. Minimum deflection as indicated on Drawings.
7. Automatic leveling valve.

2.5 ELASTOMERIC HANGERS

A. Elastomeric Mount in a Steel Frame with Upper and Lower Steel Hanger Rods: .

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Ace Mountings Co., Inc.
b. CADDY; brand of nVent Electrical plc
c. California Dynamics Corporation
d. Kinetics Noise Control, Inc
e. Mason Industries, Inc.
f. NOVIA; a division of Carpenter & Paterson
g. Vibration Eliminator Co., Inc
h. Vibration Isolation
i. Vibration Management Corp.
j. VMC GROUP

2. Frame: Steel, fabricated with a connection for an upper threaded hanger rod and an opening on the underside to allow for a maximum of 30 degrees of angular lower hanger-rod misalignment without binding or reducing isolation efficiency.
3. Damping Element: Molded, oil-resistant rubber, neoprene, or other elastomeric material with a projecting bushing for the underside opening preventing steel-to-steel contact.
4. Minimum deflection as indicated on Drawings.

2.6 SPRING HANGERS

A. Combination Coil-Spring and Elastomeric-Insert Hanger with Spring and Insert in Compression: .

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include,

but are not limited to, the following:

a. Ace Mountings Co., Inc.
b. CADDY; brand of nVent Electrical plc
c. California Dynamics Corporation
d. Kinetics Noise Control, Inc
e. Mason Industries, Inc.
f. NOVIA; a division of Carpenter & Paterson
g. Vibration Eliminator Co., Inc
h. Vibration Isolation
i. Vibration Management Corp.
j. VMC GROUP

2. Frame: Steel, fabricated for connection to threaded hanger rods and to allow for a maximum of 30 degrees of angular hanger-rod misalignment without binding or reducing isolation efficiency.
3. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
4. Minimum Additional Travel: 50 percent of the required deflection at rated load.
5. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
6. Minimum deflection as indicated on Drawings.
7. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
8. Elastomeric Element: Molded, oil-resistant rubber or neoprene. Steel-washer-reinforced cup to support spring and bushing projecting through bottom of frame.
9. Adjustable Vertical Stop: Steel washer with neoprene washer "up-stop" on lower threaded rod.
10. Self-centering hanger rod cap to ensure concentricity between hanger rod and support spring coil.

2.7 SNUBBERS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. CADDY; brand of nVent Electrical plc
2. Kinetics Noise Control, Inc
3. Mason Industries, Inc.
4. Vibration Management Corp.
5. VMC GROUP

B. Description: Factory fabricated using welded structural-steel shapes and plates, anchor bolts, and replaceable resilient isolation washers and bushings.

1. Post-Installed Concrete Anchor Bolts: Secure to concrete surface with post-installed concrete anchors. Anchors to be prequalified in accordance with ACI 355.2 testing and designated.
2. Preset Concrete Inserts: Prequalified in accordance with ICC-ES AC446 testing.
3. Anchors in Masonry: Design in accordance with TMS 402.

4. Resilient Isolation Washers and Bushings: Oil- and water-resistant neoprene.
5. Resilient Cushion: Maximum **1/4-inch** air gap, and minimum **1/4 inch** thick.

2.8 RESTRAINTS - CABLE TYPE

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. CADDY; brand of nVent Electrical plc
2. Cooper B-line; brand of Eaton, Electrical Sector
3. Gripple Inc.
4. Loos & Co. Inc.
5. VMC GROUP

B. Restraint Cables: ASTM A1023/A1023M galvanized or ASTM A603 galvanized-steel cables. End connections made of steel assemblies with thimbles, brackets, swivel, and bolts designed for restraining cable service; with fittings attached by means of poured socket, swaged socket, or mechanical (Flemish eye) loop.

2.9 POST-INSTALLED CONCRETE ANCHORS

A. Mechanical Anchor Bolts:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Atkore Unistrut
b. Cooper B-line; brand of Eaton, Electrical Sector
c. Hilti, Inc.
d. Mason Industries, Inc.
e. Powers Fasteners

2. Drilled-in and stud-wedge or female-wedge type in zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with strength required for anchor and as tested according to ASTM E488/E488M.

B. Adhesive Anchor Bolts:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Atkore Unistrut
b. Cooper B-line; brand of Eaton, Electrical Sector
c. Hilti, Inc.
d. Mason Industries, Inc.
e. Powers Fasteners

2. Drilled-in and capsule anchor system containing PVC or urethane methacrylate-based resin and accelerator, or injected polymer or hybrid mortar adhesive. Provide anchor bolts and hardware with zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with strength required for anchor and as tested according to ASTM E488/E488M.
3. Prequalify post-installed anchors in concrete in accordance with ACI 355.2 or other approved qualification testing procedures.
4. Prequalify post-installed anchors in masonry in accordance with approved qualification procedures.

C. Expansion-type anchor bolts are not permitted for equipment in excess of **10 hp** that is not vibration isolated.

1. Undercut expansion anchors are permitted.

2.10 CONCRETE INSERTS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Atkore Unistrut
2. Cooper B-line; brand of Eaton, Electrical Sector
3. Hilti, Inc.
4. Mason Industries, Inc.
5. Powers Fasteners

B. Provide preset concrete inserts that are prequalified in accordance with ICC-ES AC466 testing.

C. Comply with ANSI/MSS SP-58.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and equipment to receive vibration isolation and wind-load control devices for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine roughing-in of reinforcement and cast-in-place anchors to verify actual locations before installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 APPLICATIONS

A. Multiple Pipe Supports: Secure pipes to trapeze member with clamps approved for

application byan agency acceptable to authorities having jurisdiction.

B. Hanger-Rod Stiffeners: Install where indicated or scheduled on Drawings to receive them and where required to prevent buckling of hanger rods due to wind load forces.

C. Strength of Support Assemblies: Where not indicated, select sizes of components so strength is adequate to carry static and wind-load forces within specified loading limits.

3.3 INSTALLATION OF VIBRATION-CONTROL AND WIND-LOAD CONTROL DEVICES

A. Provide vibration-control devices for systems and equipment where indicated in Equipment Schedules or Vibration-Control Device Schedules, where indicated on Drawings, or where the Specifications indicate they are to be installed on specific equipment and systems.

B. Provide wind-load control devices for systems and equipment where indicated in Equipment Schedules or Vibration-Control Device Schedules, where indicated on Drawings, where the Specifications indicate they are to be installed on specific equipment and systems, and where required by applicable codes.

C. Coordinate location of embedded connection hardware with supported equipment attachment and mounting points and with requirements for concrete reinforcement and formwork specified in Section 033000 "Cast-in-Place Concrete."

D. Installation of vibration isolators and wind-load restraints must not cause any stresses, misalignment or change of position of equipment or piping.

E. Comply with requirements in Section 077200 "Roof Accessories" for installation of roof curbs, equipment supports, and roof penetrations.

F. Equipment Restraints:

1. Install snubbers on plumbing equipment mounted on vibration isolators. Locate snubbers as close as possible to vibration isolators and bolt to equipment base and supporting structure.
2. Install resilient bolt isolation washers on equipment anchor bolts where clearance between anchor and adjacent surface exceeds **0.125 inch**.
3. Install wind-load-restraint devices using methods approved byan agency acceptable to authorities having jurisdiction that provides required submittals for component.

G. Piping Restraints:

1. Comply with requirements in MSS SP-127.
2. Space lateral supports a maximum of 40 feet o.c., and longitudinal supports a maximum of 80 feet o.c.
3. Brace a change of direction longer than **12 feet**.

H. Install wind-load-restraint cables so they do not bend across edges of adjacent equipment or building structure.

I. Install wind-load-restraint devices using methods approved byan agency acceptable to authorities having jurisdiction that provides required submittals for component.

J. Install bushing assemblies for anchor bolts for floor-mounted equipment, arranged to provide resilient media between anchor bolt and mounting hole in concrete base.

K. Install bushing assemblies for mounting bolts for wall-mounted equipment, arranged to provide resilient media where equipment or equipment-mounting channels are attached to wall.

L. Attachment to Structure: If specific attachment is not indicated, anchor bracing to structure at flanges of beams, at upper truss chords of bar joists, or at concrete members.

M. Post-Installed Concrete Anchors:

1. Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Do not damage existing reinforcing or embedded items during coring or drilling. Notify Project structural engineer if reinforcing steel or other embedded items are encountered during drilling. Locate and avoid prestressed tendons, electrical and telecommunications conduit, and gas lines.
2. Do not drill holes in concrete or masonry until concrete, mortar, or grout has achieved full design strength.
3. Mechanical-Type Anchor Bolts: Protect threads from damage during anchor installation. Heavy-duty sleeve anchors shall be installed with sleeve fully engaged in the structural element to which anchor is to be fastened.
4. Adhesive-Type Anchor Bolts: Clean holes to remove loose material and drilling dust prior to installation of adhesive. Place adhesive in holes proceeding from the bottom of the hole and progressing toward the surface in such a manner as to avoid introduction of air pockets in the adhesive.
5. Set anchors to manufacturer's recommended torque, using a torque wrench.
6. Install zinc-coated steel anchors for interior and stainless steel anchors for exterior applications.

3.4 INSTALLATION OF AIR-SPRING ISOLATORS

A. Independent Isolator Installation:

1. Install automatic leveling valve into each air isolator.
2. Inflate each isolator to height and pressure specified on Drawings.

B. Pressure-Regulated Isolator Installation:

1. Coordinate the constant pressure-regulated air supply to air springs with requirements for piping and connections specified in Section 221513 "General-Service Compressed-Air Piping."
2. Connect all pressure regulators to a single dry, filtered facility air supply.
3. Inflate isolators to height and pressure specified on Drawings.

3.5 ACCOMMODATION OF DIFFERENTIAL MOTION

A. Provide flexible connections in piping systems where they cross structural joints and other point where differential movement may occur. Provide adequate flexibility to accommodate differential movement as determined in accordance with ASCE/SEI 7. Comply with requirements in Section 221116 "Domestic Water Piping" and Section 221119 "Domestic Water Piping Specialties" for piping flexible connections.

3.6 ADJUSTING

A. Adjust isolators after system is at operating weight.

B. Adjust limit stops on restrained-spring isolators to mount equipment at normal operating height. After equipment installation is complete, adjust limit stops so they are out of contact during normal operation.

3.7 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

C. Tests and Inspections:

1. Perform tests and inspections.
2. Provide evidence of recent calibration of test equipment by a testing agency acceptable to authorities having jurisdiction.
3. Schedule test with Owner, through Architect, before connecting anchorage device to restrained component (unless postconnection testing has been approved), and with at least seven days' advance notice.
4. Obtain Architect's approval before transmitting test loads to structure. Provide temporary load-spreading members.
5. Test no fewer than four of each type and size of installed anchors and fasteners selected by Architect.
6. Test to 90 percent of rated proof load of device.
7. Measure isolator restraint clearance.
8. Measure isolator deflection.
9. Verify snubber minimum clearances.
10. Test and adjust restrained-air-spring isolator controls and safeties.

D. Remove and replace malfunctioning units and retest as specified above.

E. Units will be considered defective if they do not pass tests and inspections.

F. Prepare test and inspection reports.

END OF SECTION 22 05 48.13

SECTION 22 05 53 - IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Equipment labels.
2. Warning signs and labels.
3. Warning tape.
4. Pipe labels.
5. Stencils.
6. Valve tags.
7. Warning tags.

B. Related Requirements:

1. Section 226113 "Compressed-Air Piping for Laboratory and Healthcare Facilities" for labeling requirements, complying with NFPA 99, for medical, compressed-air system piping and associated components in healthcare facilities.
2. Section 226213 "Vacuum Piping for Laboratory and Healthcare Facilities" for labeling requirements, complying with NFPA 99, for medical surgical, healthcare laboratory, and dental vacuum system piping, waste anesthetic gas and oral evacuation system piping, and associated components in healthcare facilities.
3. Section 226313 "Gas Piping for Laboratory and Healthcare Facilities" for labeling requirements, complying with NFPA 99, for medical carbon dioxide, laboratory carbon dioxide, medical helium, laboratory helium, medical nitrogen, laboratory nitrogen, medical nitrous oxide, laboratory nitrous oxide, medical oxygen, and laboratory oxygen.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

B. Samples: For color, letter style, and graphic representation required for each identification material and device.

C. Equipment-Label Schedule: Include a listing of all equipment to be labeled with the proposed content for each label.

D. Valve-numbering scheme.

E. Valve Schedules: For each piping system. Include in operation and maintenance manuals.

PART 2 - PRODUCTS

2.1 EQUIPMENT LABELS

A. Plastic Labels for Equipment:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

    a. Brady Corporation
    b. Carlton Industries, LP
    c. Champion America
    d. Craftmark Pipe Markers
    e. emedco
    f. Kolbi Pipe Marker Co.
    g. LEM Products Inc.
    h. Marking Services Inc.
    i. Pipemarker.com; Brimar Industries, Inc.
    j. Seton Identification Products; a Brady Corporation company

2. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch thick, with predrilled holes for attachment hardware.
3. Letter and Background Color: As indicated for specific application under Part 3.
4. Maximum Temperature: Able to withstand temperatures of up to **160 deg F**.
5. Minimum Label Size: Length and width vary for required label content, but not less than **2-1/2 by 3/4 inch**.
6. Minimum Letter Size: **1/4 inch** for name of units if viewing distance is less than **24 inches**, **1/2 inch** for viewing distances of up to **72 inches**, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
7. Fasteners: Stainless steel rivets or self-tapping screws.
8. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

B. Label Content: Include equipment's Drawing designation or unique equipment number, Drawing numbers where equipment is indicated (plans, details, and schedules), and the Specification Section number and title where equipment is specified.

2.2 WARNING SIGNS AND LABELS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Brady Corporation
2. Carlton Industries, LP
3. Champion America
4. Craftmark Pipe Markers

5. emedco
6. LEM Products Inc.
7. Marking Services Inc.
8. National Marker Company
9. Pipemarker.com; Brimar Industries, Inc.
10. Seton Identification Products; a Brady Corporation company
11. Stranco, Inc.

B. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch thick, with predrilled holes for attachment hardware.

C. Letter and Background Color: As indicated for specific application under Part 3.

D. Maximum Temperature: Able to withstand temperatures of up to **160 deg F**.

E. Minimum Label Size: Length and width vary for required label content, but not less than **2-1/2 by 3/4 inch**.

F. Minimum Letter Size: **1/4 inch** for name of units if viewing distance is less than **24 inches**, **1/2 inch** for viewing distances of up to **72 inches**, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.

G. Fasteners: Stainless steel rivets or self-tapping screws.

H. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

I. Arc-Flash Warning Signs: Provide arc-flash warning signs in locations and with content in accordance with requirements of OSHA and NFPA 70E , and other applicable codes and standards.

J. Label Content: Include caution and warning information plus emergency notification instructions.

2.3 WARNING TAPE

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Brady Corporation
2. Craftmark Pipe Markers
3. National Marker Company
4. Pipemarker.com; Brimar Industries, Inc.
5. Seton Identification Products; a Brady Corporation company

B. Material: Vinyl.

C. Minimum Thickness: **0.005 inch**.

D. Letter, Pattern, and Background Color: As indicated for specific application under Part

3.

E. Waterproof Adhesive Backing: Suitable for indoor or outdoor use.

F. Maximum Temperature: **160 deg F**.

G. Minimum Width: 2 inches.

2.4 PIPE LABELS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Actioncraft Products, Inc.; a division of Industrial Test Equipment Co., Inc.
2. Brady Corporation
3. Carlton Industries, LP
4. Champion America
5. Craftmark Pipe Markers
6. emedco
7. Kolbi Pipe Marker Co.
8. LEM Products Inc.
9. Marking Services Inc.
10. Pipemarker.com; Brimar Industries, Inc.
11. Seton Identification Products; a Brady Corporation company

B. General Requirements for Manufactured Pipe Labels: Preprinted, color coded, with lettering indicating service and showing flow direction in accordance with ASME A13.1.

C. Letter and Background Color: As indicated for specific application under Part 3.

D. Pretensioned Pipe Labels: Precoiled, semirigid plastic formed to cover full circumference of pipe and to attach to pipe without fasteners or adhesive.

E. Self-Adhesive Pipe Labels: Printed plastic with contact-type, permanent-adhesive backing.

F. Pipe Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings. Also include:

1. Pipe size.
2. Flow-Direction Arrows: Include flow-direction arrows on main distribution piping. Arrows may be either integral with label or applied separately.
3. Lettering Size: Size letters in accordance with ASME A13.1 for piping.

2.5 STENCILS

A. Stencils for Piping:

1. Manufacturers: Subject to compliance with requirements, available

manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Craftmark Pipe Markers
b. Kolbi Pipe Marker Co.
c. Marking Services Inc.
d. Pipemarker.com; Brimar Industries, Inc.

2. Lettering Size: Size letters in accordance with ASME A13.1 for piping.
3. Stencil Material: Aluminum, brass, or fiberboard.
4. Stencil Paint: Exterior, gloss, alkyd enamel in colors complying with recommendations in ASME A13.1 unless otherwise indicated. Paint may be in pressurized spray-can form.
5. Identification Paint: Exterior, alkyd enamel in colors in accordance with ASME A13.1 unless otherwise indicated. Paint may be in pressurized spray-can form.
6. Letter and Background Color: As indicated for specific application under Part 3.

2.6 VALVE TAGS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Actioncraft Products, Inc.; a division of Industrial Test Equipment Co., Inc.
2. Brady Corporation
3. Carlton Industries, LP
4. Champion America
5. Craftmark Pipe Markers
6. emedco
7. Kolbi Pipe Marker Co.
8. LEM Products Inc.
9. Marking Services Inc.
10. Pipemarker.com; Brimar Industries, Inc.
11. Seton Identification Products; a Brady Corporation company

B. Description: Stamped or engraved with **1/4-inch** letters for piping system abbreviation and **1/2-inch** numbers.

1. Tag Material: Brass, 0.04-inch minimum thickness, with predrilled or stamped holes for attachment hardware.
2. Fasteners: Brass link chain or beaded chain or S-hook.

C. Letter and Background Color: As indicated for specific application under Part 3.

D. Valve Schedules: For each piping system, on **8-1/2-by-11-inch** bond paper. Tabulate valve number, piping system, system abbreviation (as shown on valve tag), location of valve (room or space), normal operating position (open, closed, or modulating), and variations for identification. Mark valves for emergency shutoff and similar special uses.

1. Include valve-tag schedule in operation and maintenance data.

2.7 WARNING TAGS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Brady Corporation
2. Champion America
3. Craftmark Pipe Markers
4. emedco
5. Kolbi Pipe Marker Co.
6. LEM Products Inc.
7. Marking Services Inc.
8. Pipemarker.com; Brimar Industries, Inc.
9. Seton Identification Products; a Brady Corporation company

B. Description: Preprinted or partially preprinted accident-prevention tags of plasticized card stock with matte finish suitable for writing.

1. Size: 3 by 5-1/4 inches minimum.
2. Fasteners: Brass grommet and wire.
3. Nomenclature: Large-size primary caption, such as "DANGER," "CAUTION," or "DO NOT OPERATE."
4. Letter and Background Color: As indicated for specific application under Part 3.

PART 3 - EXECUTION

3.1 PREPARATION

A. Clean piping and equipment surfaces of incompatible primers, paints, and encapsulants, as well as dirt, oil, grease, release agents, and other substances that could impair bond of identification devices.

3.2 INSTALLATION, GENERAL REQUIREMENTS

A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.

B. Coordinate installation of identifying devices with locations of access panels and doors.

C. Install identifying devices before installing acoustical ceilings and similar concealment.

D. Locate identifying devices so that they are readily visible from the point of normal approach.

3.3 INSTALLATION OF EQUIPMENT LABELS, WARNING SIGNS, AND LABELS

A. Permanently fasten labels on each item of plumbing equipment.

B. Sign and Label Colors.

1. White letters on an ANSI Z535.1 safety-green background.

C. Locate equipment labels where accessible and visible.

D. Arc-Flash Warning Signs: Provide arc-flash warning signs on electrical disconnects and other equipment where are-flash hazard exists, as indicated on Drawings, and in accordance with requirements of OSHA and NFPA 70E , and other applicable codes and standards.

3.4 INSTALLATION OF WARNING TAPE

A. Warning Tape Color and Pattern: Yellow background with black diagonal stripes.

B. Install warning tape on pipes and ducts, with cross-designated walkways providing less than **6 ft.** of clearance.

C. Locate tape so as to be readily visible from the point of normal approach.

3.5 INSTALLATION OF PIPE LABELS

A. Piping Color Coding: Painting of piping is specified in Section 099600 "High-Performance Coatings."

B. Install pipe labels showing service and flow direction with permanent adhesive on pipes.

C. Stenciled Pipe Label Option: Stenciled labels showing service and flow direction may be provided instead of manufactured pipe labels, at Installer's option. Install stenciled pipe labels, complying with ASME A13.1, with painted, color-coded bands or rectangles on each piping system.

1. Identification Paint: Use for contrasting background.
2. Stencil Paint: Use for pipe marking.

D. Pipe-Label Locations: Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior exposed locations as follows:

1. Within **3 ft.** of each valve and control device.
2. At access doors, manholes, and similar access points that permit view of concealed piping.
3. Within **3 ft.** of equipment items and other points of origination and termination.
4. Spaced at maximum intervals of 25 ft. along each run. Reduce intervals to 10 ft. in areas of congested piping and equipment.

E. Do not apply plastic pipe labels or plastic tapes directly to bare pipes conveying fluids at temperatures of **125 deg F** or higher. Where these pipes are to remain uninsulated, use a short section of insulation or use stenciled labels.

F. Flow-Direction Flow Arrows: Use arrows, in compliance with ASME A13.1, to indicate direction of flow in pipes, including pipes where flow is allowed in both directions.

G. Pipe-Label Color Schedule:

1. Low-Pressure Compressed-Air Piping: White letters on an ANSI Z535.1 safety-blue background.
2. High-Pressure Compressed-Air Piping: White letters on an ANSI Z535.1 safety-blue background.
3. Vacuum Piping: White letters on an ANSI Z535.1 Safety blue background.
4. Domestic Cold-Water Piping: White letters on an ANSI Z535.1 safety-green background.
5. Domestic Hot-Water Piping: White letters on an ANSI Z535.1 safety-green background
6. Domestic Hot-Water Return Piping White letters on an ANSI Z535.1 safety-green background.
7. Sanitary Waste and Storm Drainage Piping: White letters on a black background.
8. Nonpotable Cold Water: Black letters on an ANSI Z535.1 safety-yellow background.
9. Nonpotable Hot Water: Black letters on an ANSI Z535.1-yellow background.
10. Nonpotable Hot-Water Recirculation: Black letters on an ANSI Z535.1 safety-yellow background.
11. Reagent Water Piping: White letters on an ANSI Z535.1 safety-blue background.
12. Deionized Water Piping: White letters on an ANSI Z535.1 safety-blue background.
13. Distilled Water Piping: White letters on an ANSI Z535.1 safety-blue background.
14. Reverse Osmosis Water Piping: White letters on an ANSI Z535.1 safety-blue background.

3.6 INSTALLATION OF VALVE TAGS

A. Install tags on valves and control devices in piping systems, except check valves, valves within factory-fabricated equipment units, shutoff valves, faucets, convenience and lawn-watering hose connections, and similar roughing-in connections of end-use fixtures and units. List tagged valves in a valve schedule in the operating and maintenance manual.

B. Valve-Tag Application Schedule: Tag valves according to size, shape, and color scheme and with captions similar to those indicated in "Valve-Tag Size and Shape" Subparagraph below:

1. Valve-Tag Size and Shape:

a. Domestic Cold Water: 1-1/2 inches, round.
b. Domestic Hot Water: 1-1/2 inches, round.
c. Domestic Hot-Water Return: 1-1/2 inches, round.
d. Nonpotable Cold Water: 1-1/2 inches, round.

2. Valve-Tag Colors:

a. For each piping system, use the same lettering and background coloring system on valve tags as used in the piping system labels and background.

3.7 INSTALLATION OF WARNING TAGS

A. Warning Tag Color: Black letters on an ANSI Z535.1 safety-yellow background.

B. Attach warning tags, with proper message, to equipment and other items where indicated on Drawings.

END OF SECTION 22 05 53

SECTION 22 07 16 - PLUMBING EQUIPMENT INSULATION

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes insulating the following plumbing equipment that is not factory insulated:

1. Domestic water boiler breechings.
2. Domestic water heat exchangers.
3. Domestic water converters.
4. Domestic water, hot-water cold-water and pumps.
5. Domestic water storage tanks.
6. Domestic water filter housings.

B. Related Sections:

1. Section 220719 "Plumbing Piping Insulation."

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product. Include thermal conductivity, water-vapor permeance thickness, and jackets (both factory and field applied, if any).

B. Sustainable Design Submittals:

1. Product Data: For recycled content, indicating postconsumer and preconsumer recycled content and cost.
2. Product Data: For adhesives, mastics, and sealants, indicating VOC content.
3. Laboratory Test Reports: For adhesives, mastics, and sealants, indicating compliance with requirements for low-emitting materials.

C. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.

1. Detail removable insulation at equipment connections.
2. Detail application of field-applied jackets.
3. Detail application at linkages of control devices.
4. Detail field application for each equipment type.

D. Samples: For each type of insulation and jacket indicated. Identify each Sample, describing product and intended use. Sample sizes are as follows:

1. Sheet Form Insulation Materials: **12 inches** square.
2. Sheet Jacket Materials: **12 inches** square.
3. Manufacturer's Color Charts: For products where color is specified, show the full range of colors available for each type of finish material.

1.3 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified Installer.

B. Material Test Reports: From a qualified testing agency acceptable to authorities having jurisdiction indicating, interpreting, and certifying test results for compliance of insulation materials, sealers, attachments, cements, and jackets, with requirements indicated. Include dates of tests and test methods employed.

C. Field quality-control reports.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program .

1.5 DELIVERY, STORAGE, AND HANDLING

A. Packaging: Insulation system materials are to be delivered to the Project site in unopened containers. The packaging is to include, the name of the manufacturer, fabricator, type, description, and size .

1.6 COORDINATION

A. Coordinate sizes and locations of supports, hangers, and insulation shields specified in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment."

B. Coordinate clearance requirements with equipment Installer for equipment insulation application.

C. Coordinate installation and testing of heat tracing.

1.7 SCHEDULING

A. Schedule insulation application after pressure testing systems and, where required, after installing and testing heat tracing. Insulation application may begin on segments that have satisfactory test results.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products in accordance with ASTM E84, by a testing agency acceptable to authorities having jurisdiction. Factory label insulation, jacket materials, adhesive, mastic, tapes, and cement material containers with appropriate markings of

applicable testing agency.

1. All Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
2. All Insulation Installed Indoors; Outdoors-Installed Insulation in Contact with Airstream: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
3. All Insulation Installed Indoors and Outdoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.

2.2 INSULATION MATERIALS

A. Calcium Silicate: Flat-, curved-, and grooved-block sections of noncombustible, inorganic, hydrous calcium silicate with a non-asbestos fibrous reinforcement. Comply with ASTM C533, Type I or Type II.

1. Prefabricated Fitting Covers: Comply with ASTM C450 and ASTM C585 for dimensions used in preforming insulation to cover valves, elbows, tees, and flanges.

    a. Manufacturers: Subject to compliance with requirements, provide products by the following:

        1) Johns Manville; a Berkshire Hathaway company

B. Cellular Glass: Inorganic, incombustible, foamed or cellulated glass with annealed, rigid, hermetically sealed cells. Comply with ASTM C552.

1. Manufacturers: Subject to compliance with requirements, provide products by the following:

    a. Owens Corning

2. Block Insulation: Type I.
3. Special-Shaped Insulation: Type III.
4. Board Insulation: Type IV.
5. Factory fabricate shapes in accordance with ASTM C450 and ASTM C585.
6. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

C. Flexible Elastomeric: Closed-cell or expanded-rubber materials; suitable for maximum use temperature between **minus 70 deg F** and **220 deg F**. Comply with ASTM C534/C534M, Type II for sheet materials.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

    a. Aeroflex USA
    b. Armacell LLC

c. K-Flex USA

D. Glass-Fiber Blanket: Glass fibers bonded with a thermosetting resin; suitable for maximum use temperature up to **450 deg F** in accordance with ASTM C411). Comply with ASTM C553, Type II, and ASTM C1290, Type III, with factory-applied FSK jacket. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. CertainTeed; SAINT-GOBAIN
b. Johns Manville; a Berkshire Hathaway company
c. Knauf Insulation
d. Manson Insulation Inc.
e. Owens Corning

2.3 ADHESIVES

A. Materials are compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated unless otherwise indicated.

B. Calcium Silicate Adhesive: Fibrous, sodium-silicate-based adhesive with a service temperature range of **50 to 800 deg F**.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Childers Brand; H. B. Fuller Construction Products
b. Foster Brand; H. B. Fuller
c. Mon-Eco Industries, Inc.
d. Vimasco Corporation

2. Adhesive: As recommended by calcium silicate manufacturer and with a VOC content of 50 g/L or less.
3. Adhesive shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
4. Adhesive shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
5. Adhesive shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers." Formaldehyde emissions shall not exceed 9 mcg/cu. m or 7 ppb, whichever is less.
6. Adhesive shall comply with the testing and product requirements of the California

Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

7. Adhesive shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers." The building concentration of formaldehyde shall not exceed half of the indoor recommended exposure limit or 33 mcg/cu. m and that of acetaldehyde shall not exceed 9 mcg/cu. m.

C. Cellular-Glass Adhesive: Two-component, thermosetting urethane adhesive containing no flammable solvents, with a service temperature range of **minus 100 to plus 200 deg F**.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

   a. Childers Brand; H. B. Fuller Construction Products
   b. Foster Brand; H. B. Fuller

2. Adhesive: As recommended by cellular glass manufacturer and with a VOC content of 80 g/L or less.
3. Adhesive shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
4. Adhesive shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
5. Adhesive shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers." Formaldehyde emissions shall not exceed 9 mcg/cu. m or 7 ppb, whichever is less.
6. Adhesive shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
7. Adhesive shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers." The building concentration of formaldehyde shall not exceed half of the indoor recommended exposure limit or 33 mcg/cu. m and that of acetaldehyde shall not exceed 9 mcg/cu. m.

D. Flexible Elastomeric and Polyolefin Adhesive: Solvent-based adhesive.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include,

but are not limited to, the following:

a. Aeroflex USA
b. Armacell LLC
c. K-Flex USA

2. Adhesive: As recommended by flexible elastomeric and polyolefin manufacturer and with a VOC content of 80 g/L or less.
3. Adhesive shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
4. Adhesive shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
5. Adhesive shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers." Formaldehyde emissions shall not exceed 9 mcg/cu. m or 7 ppb, whichever is less.
6. Adhesive shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
7. Adhesive shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers." The building concentration of formaldehyde shall not exceed half of the indoor recommended exposure limit or 33 mcg/cu. m and that of acetaldehyde shall not exceed 9 mcg/cu. m.
8. Flame-spread index is 25 or less and smoke-developed index is 50 or less as tested in accordance with ASTM E84.
9. Wet Flash Point: Below **0 deg F**
10. Service Temperature Range: **40 to 200 deg F**.
11. Color: Black.

E. ASJ Adhesive, and FSK Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Childers Brand; H. B. Fuller Construction Products
b. Foster Brand; H. B. Fuller
c. Mon-Eco Industries, Inc.

2. Adhesives shall have a VOC content of 50 g/L or less.
3. Adhesive shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation

of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

4. Adhesive shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
5. Adhesive shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers." Formaldehyde emissions shall not exceed 9 mcg/cu. m or 7 ppb, whichever is less.
6. Adhesive shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
7. Adhesive shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers." The building concentration of formaldehyde shall not exceed half of the indoor recommended exposure limit or 33 mcg/cu. m and that of acetaldehyde shall not exceed 9 mcg/cu. m.

2.4 MASTICS AND COATINGS

A. Materials are compatible with insulation materials, jackets, and substrates.

1. Mastics: As recommended by insulation manufacturer and with a VOC content of 50 g/L or less.
2. Mastics shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
3. Mastics shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
4. Mastics shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers." Formaldehyde emissions shall not exceed 9 mcg/cu. m or 7 ppb, whichever is less.
5. Mastics shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
6. Mastics shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers." The building concentration of formaldehyde shall not exceed half of the indoor recommended exposure limit, or 33 mcg/cu. m, and that

of acetaldehyde shall not exceed 9 mcg/cu. m.

B. Vapor-Retarder Mastic, Water Based: Suitable for indoor use on below-ambient services.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

   a. Childers Brand; H. B. Fuller Construction Products
   b. Foster Brand; H. B. Fuller
   c. Knauf Insulation
   d. Mon-Eco Industries, Inc.
   e. Vimasco Corporation

2. Water-Vapor Permeance: Comply with ASTM E96/E96M or ASTM F1249.
3. Service Temperature Range: 0 to plus 180 deg F.
4. Comply with MIL-PRF-19565C, Type II, for permeance requirements , with supplier listing on DOD QPD - Qualified Products Database.
5. Color: White.

C. Vapor-Retarder Mastic, Solvent Based, Indoor Use: Suitable for indoor use on below-ambient services.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

   a. Childers Brand; H. B. Fuller Construction Products
   b. Foster Brand; H. B. Fuller
   c. Mon-Eco Industries, Inc.

2. Water-Vapor Permeance: Comply with ASTM E96/E96M or ASTM F1249.
3. Service Temperature Range: **0 to 180 deg F**.
4. Color: White.

2.5 SEALANTS

A. Materials are as recommended by the insulation manufacturer and are compatible with insulation materials, jackets, and substrates.

B. Joint Sealants:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

   a. Childers Brand; H. B. Fuller Construction Products
   b. Foster Brand; H. B. Fuller
   c. Mon-Eco Industries, Inc.

d. Owens Corning

2. Permanently flexible, elastomeric sealant.
3. Service Temperature Range: Minus 150 to plus 250 deg F.
4. Color: White or gray.
5. Sealant shall have a VOC content of 420 g/L or less.
6. Sealant shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
7. Sealant shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
8. Sealant shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers." Formaldehyde emissions shall not exceed 9 mcg/cu. m or 7 ppb, whichever is less.
9. Sealant shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
10. Sealant shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers." The building concentration of formaldehyde shall not exceed half of the indoor recommended exposure limit, or 33 mcg/cu. m, and that of acetaldehyde shall not exceed 9 mcg/cu. m.

C. FSK and Metal Jacket Flashing Sealants:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

   a. Childers Brand; H. B. Fuller Construction Products
   b. Foster Brand; H. B. Fuller
   c. Mon-Eco Industries, Inc.

2. Fire- and water-resistant, flexible, elastomeric sealant.
3. Service Temperature Range: **Minus 40 to plus 250 deg F**.
4. Color: Aluminum.
5. Sealant shall have a VOC content of 420 g/L or less.
6. Sealant shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
7. Sealant shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using

Environmental Chambers."

8. Sealant shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers." Formaldehyde emissions shall not exceed 9 mcg/cu. m or 7 ppb, whichever is less.
9. Sealant shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
10. Sealant shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers." The building concentration of formaldehyde shall not exceed half of the indoor recommended exposure limit, or 33 mcg/cu. m, and that of acetaldehyde shall not exceed 9 mcg/cu. m.

D. ASJ Flashing Sealants and Vinyl, PVDC, and PVC Jacket Flashing Sealants:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

    a. Childers Brand; H. B. Fuller Construction Products
    b. Foster Brand; H. B. Fuller

2. Fire- and water-resistant, flexible, elastomeric sealant.
3. Service Temperature Range: **Minus 40 to plus 250 deg F**.
4. Color: White.
5. Sealant shall have a VOC content of 420 g/L or less.
6. Sealant shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
7. Sealant shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
8. Sealant shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers." Formaldehyde emissions shall not exceed 9 mcg/cu. m or 7 ppb, whichever is less.
9. Sealant shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
10. Sealant shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers." The building concentration of formaldehyde shall not

exceed half of the indoor recommended exposure limit, or 33 mcg/cu. m, and that of acetaldehyde shall not exceed 9 mcg/cu. m.

2.6 FACTORY-APPLIED JACKETS

A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:

1. ASJ: White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C1136, Type I.
2. ASJ-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C1136, Type I.
3. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C1136, Type II.

2.7 FIELD-APPLIED JACKETS

A. Field-applied jackets comply with ASTM C1136, Type I, unless otherwise indicated.

B. FSK Jacket: Aluminum-foil-face, fiberglass-reinforced scrim with kraft-paper backing.

C. Metal Jacket:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

   a. Johns Manville; a Berkshire Hathaway company
   b. RPR Products, Inc.

2. Aluminum Jacket: Comply with **ASTM B209**, Alloy 3003, 3005, 3105, or 5005, Temper H-14.

   a. Sheet and roll stock ready for shop or field sizing.
   b. Finish and thickness are indicated in field-applied jacket schedules.
   c. Moisture Barrier for Indoor Applications: 3-mil- thick, heat-bonded polyethylene and kraft paper.
   d. Moisture Barrier for Outdoor Applications: 3-mil- thick, heat-bonded polyethylene and kraft paper.
   e. Factory-Fabricated Fitting Covers:

      1) Same material, finish, and thickness as jacket.
      2) Preformed two-piece or gore, 45- and 90-degree, short- and long-radius elbows.
      3) Tee covers.
      4) Flange and union covers.
      5) End caps.
      6) Beveled collars.
      7) Valve covers.

8) Field fabricate fitting covers only if factory-fabricated fitting covers are not available.

3. Stainless Steel Jacket: ASTM A240/A240M.

a. Sheet and roll stock ready for shop or field sizing.
b. Material, finish, and thickness are indicated in field-applied jacket schedules.
c. Moisture Barrier for Indoor Applications: 3-mil- thick, heat-bonded polyethylene and kraft paper.
d. Moisture Barrier for Outdoor Applications: 3-mil- thick, heat-bonded polyethylene and kraft paper.
e. Factory-Fabricated Fitting Covers:

1) Same material, finish, and thickness as jacket.
2) Preformed two-piece or gore, 45- and 90-degree, short- and long-radius elbows.
3) Tee covers.
4) Flange and union covers.
5) End caps.
6) Beveled collars.
7) Valve covers.
8) Field fabricate fitting covers only if factory-fabricated fitting covers are not available.

2.8 FIELD-APPLIED FABRIC-REINFORCING MESH

A. Woven Glass-Fiber Mesh: Approximately **4 oz./sq. yd.** with a thread count of **5 strands by 5 strands/sq. in.** for covering equipment.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Childers Brand; H. B. Fuller Construction Products
b. Foster Brand; H. B. Fuller

B. Woven Polyester Mesh: Approximately **1 oz./sq. yd.** with a thread count of **10 strands by 10 strands/sq. in.**, in a Leno weave, for equipment.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Childers Brand; H. B. Fuller Construction Products
b. Foster Brand; H. B. Fuller
c. Vimasco Corporation

2.9 FIELD-APPLIED CLOTHS

A. Woven Glass-Fiber Cloth: Comply with MIL-C-20079H, Type I, plain weave, and presized a minimum of **8 oz./sq. yd.**.

1. Manufacturers: Subject to compliance with requirements, provide products by the following:

    a. Alpha Associates, Inc.

2.10 TAPES

A. Aluminum-Foil Tape: Vapor-retarder tape with acrylic adhesive.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

    a. 3M Industrial Adhesives and Tapes Division
    b. Avery Dennison Corporation, Specialty Tapes Division
    c. Ideal Tape Co., Inc., an American Biltrite Company
    d. Knauf Insulation

2. Width: 2 inches.
3. Thickness: 3.7 mils.
4. Adhesion: 100 ounces force/inch in width.
5. Elongation: 5 percent.
6. Tensile Strength: 34 lbf/inch in width.

2.11 SECUREMENTS

A. Bands:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

    a. Johns Manville; a Berkshire Hathaway company
    b. RPR Products, Inc.

2. Stainless Steel: ASTM A240/A240M, Type 304 or Type 316; **0.015 inch** thick, 3/4 inch wide with wing seal or closed seal.
3. Aluminum: **ASTM B209**, Alloy 3003, 3005, 3105, or 5005; Temper H-14, **0.020 inch** thick, 3/4 inch wide with wing seal or closed seal.
4. Springs: Twin spring set constructed of stainless steel with ends flat and slotted to accept metal bands. Spring size is determined by manufacturer for application.

B. Insulation Pins and Hangers:

1. Insulation-Retaining Washers: Self-locking washers formed from **0.016-inch-**

thick, galvanized-steel sheet, with beveled edge sized as required to hold insulation securely in place but not less than **1-1/2 inches** in diameter.

a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1) AGM Industries, Inc
2) Gemco
3) Midwest Fasteners, Inc
4) Nelson Stud Welding

b. Protect ends with capped self-locking washers incorporating a spring steel insert to ensure permanent retention of cap in exposed locations.

2. Nonmetal Insulation-Retaining Washers: Self-locking washers formed from **0.016-inch-** thick nylon sheet, with beveled edge sized as required to hold insulation securely in place but not less than **1-1/2 inches** in diameter.

C. Staples: Outward-clinching insulation staples, nominal **3/4-inch-** wide, stainless steel or Monel.

D. Wire: 0.080-inch nickel-copper alloy.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. C & F Wire Products
b. Johns Manville; a Berkshire Hathaway company

2.12 CORNER ANGLES

A. PVC Corner Angles: 30-mils thick, minimum **1- by 1-inch** PVC in accordance with ASTM D1784, Class 16354-C, white or color-coded to match adjacent surface.

B. Aluminum Corner Angles: 0.040-inch thick, minimum **1- by 1-inch**, aluminum in accordance with **ASTM B209**, Alloy 3003, 3005, 3105, or 5005; Temper H-14.

C. Stainless Steel Corner Angles: 0.024-inch thick, minimum **1- by 1-inch** stainless steel in accordance with ASTM A240/A240M, Type 304 or Type 316.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of insulation application.

1. Verify that systems and equipment to be insulated have been tested and are free of defects.
2. Verify that surfaces to be insulated are clean and dry.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.

B. Clean and prepare surfaces to be insulated. Before insulating, apply a corrosion coating to insulated surfaces as follows:

1. Stainless Steel: Coat 300 series stainless steel with an epoxy primer **5 mils** thick and an epoxy finish **5 mils** thick if operating in a temperature range between **140 and 300 deg F**. Consult coating manufacturer for appropriate coating materials and application methods for operating temperature range.
2. Carbon Steel: Coat carbon steel operating at a service temperature between **32 and 300 deg F** with an epoxy coating. Consult coating manufacturer for appropriate coating materials and application methods for operating temperature range.

C. Coordinate insulation installation with the tradesman installing heat tracing. Comply with requirements for heat tracing that apply to insulation.

D. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless steel surfaces, use demineralized water.

3.3 GENERAL INSTALLATION REQUIREMENTS

A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of equipment.

B. Install insulation materials, forms, vapor barriers or retarders, jackets, and of thicknesses required for each item of equipment, as specified in insulation system schedules.

C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.

D. Install insulation with longitudinal seams at top and bottom of horizontal runs.

E. Install multiple layers of insulation with longitudinal and end seams staggered.

F. Keep insulation materials dry during storage, application, and finishing. Replace insulation materials that get wet during storage or in the installation process before being properly covered and sealed in accordance with Contract Documents , unless otherwise approved by the engineer of record.

G. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.

H. Install insulation with least number of joints practical.

I. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.

1. Install insulation continuously through hangers and around anchor attachments.
2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends attached to structure with vapor-barrier mastic.
3. Install insert materials and insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
4. Cover inserts with jacket material matching adjacent insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.

J. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.

K. Install insulation with factory-applied jackets as follows:

1. Draw jacket tight and smooth, but not to the extent of creating wrinkles or area of compression in the insulation.
2. Cover circumferential joints with **3-inch-** wide strips, of same material as insulation jacket. Secure strips with adhesive and outward-clinching staples along both edges of strip, spaced **4 inches** o.c.
3. Overlap jacket longitudinal seams at least **1-1/2 inches**. Clean and dry surface to receive self-sealing lap. Staple laps with outward-clinching staples along edge at 2 inches o.c.

    a. For below-ambient services, apply vapor-barrier mastic over staples.

4. Cover joints and seams with tape, in accordance with insulation material manufacturer's written instructions, to maintain vapor seal.
5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints.

L. Cut insulation in a manner to avoid compressing insulation.

M. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.

N. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least **4 inches** beyond damaged areas. Adhere, staple, and seal patches in similar fashion to butt joints.

O. For above-ambient services, do not install insulation to the following:

1. Vibration-control devices.
2. Testing agency labels and stamps.
3. Nameplates and data plates.
4. Manholes.
5. Handholes.
6. Cleanouts.

3.4 INSTALLATION OF EQUIPMENT, TANK, AND VESSEL INSULATION

A. Glass-Fiber, Pipe and Tank Insulation Installation for Tanks and Vessels: Secure insulation with adhesive and anchor pins and speed washers.

1. Apply adhesives in accordance with manufacturer's recommended coverage rates per unit area, for 100 percent coverage of tank and vessel surfaces.
2. Groove and score insulation materials to fit as closely as possible to equipment, including contours. Bevel insulation edges for cylindrical surfaces for tight joints. Stagger end joints.
3. Protect exposed corners with secured corner angles.
4. Install adhesively attached or self-sticking insulation hangers and speed washers on sides of tanks and vessels as follows:

    a. Do not weld anchor pins to ASME-labeled pressure vessels.
    b. Select insulation hangers and adhesive that are compatible with service temperature and with substrate.
    c. On tanks and vessels, maximum anchor-pin spacing is **3 inches** from insulation end joints and **16 inches** o.c. in both directions.
    d. Do not compress insulation during installation.
    e. Cut and miter insulation segments to fit curved sides and domed heads of tanks and vessels.
    f. Impale insulation over anchor pins, and attach speed washers.
    g. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.

5. Secure each layer of insulation with stainless steel or aluminum bands. Select band material compatible with insulation materials.
6. Where insulation hangers on equipment and vessels are not permitted or practical and where insulation support rings are not provided, install a girdle network for securing insulation. Stretch prestressed aircraft cable around the diameter of vessel and make taut with clamps, turnbuckles, or breather springs. Place one circumferential girdle around equipment approximately **6 inches** from each end. Install wire or cable between two circumferential girdles **12 inches** o.c. Install a wire ring around each end and around outer periphery of center openings, and stretch prestressed aircraft cable radially from the wire ring to nearest circumferential girdle. Install additional circumferential girdles along the body of equipment or tank at a minimum spacing of **48 inches** o.c. Use this network for securing insulation with tie wire or bands.
7. Stagger joints between insulation layers at least **3 inches**.
8. Install insulation in removable and replaceable segments on equipment access doors, manholes, handholes, and other elements that require frequent removal

for service and inspection.

9. Bevel and seal insulation ends around manholes, handholes, ASME stamps, and nameplates.
10. For equipment with surface temperatures below ambient, apply mastic to open ends, joints, seams, breaks, and punctures in insulation.

B. Flexible Elastomeric Thermal Insulation Installation for Tanks and Vessels: Install insulation over entire surface of tanks and vessels.

1. Apply 100 percent coverage of adhesive to surface with manufacturer's recommended adhesive.
2. Seal longitudinal seams and end joints.

C. Insulation Installation on Pumps:

1. Fabricate metal boxes lined with insulation. Fit boxes around pumps and coincide box joints with splits in pump casings. Fabricate joints with outward bolted flanges. Bolt flanges on **6-inch** centers, starting at corners. Install **3/8-inch-** diameter fasteners with wing nuts. Alternatively, secure the box sections together using a field-adjustable latching mechanism.
2. Fabricate boxes from galvanized steel aluminum or stainless steel, at least 0.040 inch thick.
3. For below-ambient services, install a vapor barrier at seams, joints, and penetrations. Seal between flanges with replaceable gasket material to form a vapor barrier.

3.5 INSTALLATION OF CALCIUM SILICATE INSULATION

A. Insulation Installation on Domestic Water Boiler Breechings:

1. Secure single-layer insulation with stainless steel bands at **12-inch** intervals, and tighten bands without deforming insulation material.
2. Install two-layer insulation with joints tightly butted and staggered at least **3 inches**. Secure inner layer with wire spaced at **12-inch** intervals. Secure outer layer with stainless steel bands at **12-inch** intervals.
3. On exposed applications without metal jacket, finish insulation surface with a skim coat of mineral-fiber, hydraulic-setting cement. When cement is dry, apply flood coat of lagging adhesive and press on one layer of glass cloth. Overlap edges at least **1 inch**. Apply finish coat of lagging adhesive over glass cloth. Thin finish coat to achieve smooth, uniform finish.

3.6 INSTALLATION OF FLEXIBLE ELASTOMERIC INSULATION

A. Install in accordance with manufacturer's written installation instructions and ASTM C1710.

B. Seal longitudinal seams and end joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

3.7 INSTALLATION OF FIELD-APPLIED JACKET

A. Where glass-cloth jackets are indicated, install directly over bare insulation or insulation with factory-applied jackets.

1. Draw jacket smooth and tight to surface with **2-inch** overlap at seams and joints.
2. Embed glass cloth between two **0.062-inch-** thick coats of lagging adhesive.
3. Completely encapsulate insulation with coating, leaving no exposed insulation.

B. Where FSK jackets are indicated, install as follows:

1. Draw jacket material smooth and tight.
2. Install lap or joint strips with same material as jacket.
3. Secure jacket to insulation with manufacturer's recommended adhesive.
4. Install jacket with **1-1/2-inch** laps at longitudinal seams and **3-inch-** wide joint strips at end joints.
5. Seal openings, punctures, and breaks in vapor-retarder jackets and exposed insulation with vapor-barrier mastic.

C. Where PVC jackets are indicated, install with **1-inch** overlap at longitudinal seams and end joints; for horizontal applications, install with longitudinal seams along top and bottom of tanks and vessels. Seal with manufacturer's recommended adhesive.

1. Apply two continuous beads of adhesive to seams and joints, one bead under lap and the finish bead along seam and joint edge.

D. Where metal jackets are indicated, install with **2-inch** overlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal end joints with weatherproof sealant recommended by insulation manufacturer. Secure jacket with stainless steel bands **12 inches** o.c. and at end joints.

E. Where PVDC jackets are indicated, install as follows:

1. Jacket can be wrapped in cigarette fashion along length of roll for insulation systems with an outer circumference of **33-1/2 inches** or less. **33-1/2-inch-** circumference limit allows for **2-inch-** overlap seal. Using the length of roll allows for longer sections of jacket to be installed at one time. Use adhesive on the lap seal. Visually inspect lap seal for "fishmouthing," and use PVDC tape along lap seal to secure joint.
2. Repair holes or tears in PVDC jacket by placing PVDC tape over the hole or tear and wrapping a minimum of 1-1/4 circumferences to avoid damage to tape edges.

3.8 FINISHES

A. Equipment Insulation with ASJ, Glass-Cloth, or Other Paintable Jacket Material: Paint jacket with paint system identified below and as specified in Section 099113 "Exterior Painting" and Section 099123 "Interior Painting."

1. Flat Acrylic Finish: Two finish coats over a primer that is compatible with jacket

material and finish coat paint. Add fungicidal agent to render fabric mildew proof.

a. Finish Coat Material: Interior, flat, latex-emulsion size.

B. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of insulation manufacturer's recommended protective coating.

C. Color: Final color as selected by Architect. Vary first and second coats to allow visual inspection of the completed Work.

D. Do not field paint aluminum or stainless steel jackets.

3.9 FIELD QUALITY CONTROL

A. Owner will engage a qualified testing agency to perform tests and inspections.

B. Engage a qualified testing agency to perform tests and inspections.

C. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

D. Perform tests and inspections .

E. Tests and Inspections: Inspect field-insulated equipment, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection is limited to one location(s) for each type of equipment defined in the "Indoor Equipment Insulation Schedule" Article. For large equipment, remove only a portion adequate to determine compliance.

F. All insulation applications will be considered defective if they do not pass tests and inspections.

G. Prepare test and inspection reports.

3.10 DOMESTIC WATER BOILER BREECHING INSULATION SCHEDULE

A. Round, exposed breeching and connector insulation are one of the following:

1. Calcium Silicate: **4 inches** thick.
2. High-Temperature Glass-Fiber Blanket: **3 inches** thick and **3 lb/cu. ft.** nominal density.
3. Mineral Wool Blanket: **3 inches** thick and **4 lb/cu. ft.** nominal density.

B. Round, concealed breeching and connector insulation are one of the following:

1. Calcium Silicate: **4 inches** thick.
2. High-Temperature Glass-Fiber Blanket: **3 inches** thick and **3 lb/cu. ft.** nominal density.
3. Mineral Wool Blanket: **3 inches** thick and **4 lb/cu. ft.** nominal density.

C. Rectangular, exposed breeching and connector insulation are one of the following:

1. Calcium Silicate: **4 inches** thick.
2. High-Temperature Glass-Fiber Blanket: **3 inches** thick and **3 lb/cu. ft.** nominal density.
3. High-Temperature Glass-Fiber Board: **3 inches** thick and 3 lb/cu. ft. nominal density.
4. Mineral Wool Blanket: **3 inches** thick and **4 lb/cu. ft.** nominal density.
5. Mineral Wool Board: **3 inches** thick and 4 lb/cu. ft. nominal density.

D. Rectangular, concealed breeching and connector insulation are one of the following:

1. Calcium Silicate: **4 inches** thick.
2. High-Temperature Glass-Fiber Blanket: **3 inches** thick and **3 lb/cu. ft.** nominal density.
3. High-Temperature Glass-Fiber Board: **3 inches** thick and 3 lb/cu. ft. nominal density.
4. Mineral Wool Blanket: **3 inches** thick and 4 lb/cu. ft. nominal density.
5. Mineral Wool Board: **3 inches** thick and 4 lb/cu. ft. nominal density.

3.11 INDOOR EQUIPMENT INSULATION SCHEDULE

A. Insulate indoor and outdoor equipment that is not factory insulated.

B. Heat-exchanger (water-to-water for domestic water-heating service) insulation is one of the following:

1. Calcium Silicate: 3 inches thick.
2. Cellular Glass: 3 inches thick.
3. Glass-Fiber Blanket: 2 inches thick and 2 lb/cu. ft. nominal density.
4. Glass-Fiber Board: 2 inches thick and 2 lb/cu. ft. nominal density.
5. Glass-Fiber Pipe and Tank: 2 inches thick.
6. Mineral Wool Blanket: 2 inch thick and 4 lb/cu. ft. nominal density.
7. Mineral Wool Board: 2 inch thick and 4 lb/cu. ft. nominal density.
8. Mineral Wool Pipe and Tank: 2 inch thick.

C. Steam-to-hot-water converter insulation is one of the following:

1. Calcium Silicate: 3 inches thick.
2. Cellular Glass: 3 inches thick.
3. Glass-Fiber Blanket: 2 inches thick and 2 lb/cu. ft. nominal density.
4. Glass-Fiber Board: 2 inches thick and 2 lb/cu. ft. nominal density.
5. Glass-Fiber Pipe and Tank: 2 inches thick.
6. Mineral Wool Blanket: 2 inch thick and 4 lb/cu. ft. nominal density.
7. Mineral Wool Board: 2 inch thick and 4 lb/cu. ft. nominal density.
8. Mineral Wool Pipe and Tank: 2 inch thick.

D. Domestic water pump insulation is one of the following:

1. Cellular Glass: 2 inches thick.

2. Glass-Fiber Blanket: 1 inch thick and 2 lb/cu. ft. nominal density.
3. Glass-Fiber Board: 1 inch thick and 2 lb/cu. ft. nominal density.
4. Mineral Wool Blanket: 1 inch thick and 4 lb/cu. ft. nominal density.
5. Mineral Wool Board: 1 inch thick and 4 lb/cu. ft. nominal density.

E. Domestic chilled-water (potable) pump insulation is one of the following:

1. Cellular Glass: 3 inches thick.
2. Glass-Fiber Blanket: 2 inches thick and 2 lb/cu. ft. nominal density.
3. Glass-Fiber Board: 2 inches thick and 2 lb/cu. ft. nominal density.
4. Mineral Wool Blanket: 2 inch thick and 4 lb/cu. ft. nominal density.
5. Mineral Wool Board: 2 inch thick and 4 lb/cu. ft. nominal density.

F. Domestic hot-water pump insulation is one of the following:

1. Cellular Glass: 2 inches thick.
2. Glass-Fiber Blanket: 1 inch thick and 2 lb/cu. ft. nominal density.
3. Glass-Fiber Board: 1 inch thick and 2 lb/cu. ft. nominal density.
4. Mineral Wool Blanket: 1 inch thick and 4 lb/cu. ft. nominal density.
5. Mineral Wool Board: 1 inch thick and 4 lb/cu. ft. nominal density.

G. Domestic water, domestic chilled-water (potable), and domestic hot-water hydropneumatic tank insulation are one of the following:

1. Cellular Glass: 2 inches thick.
2. Flexible Elastomeric: 1 inch thick.
3. Glass-Fiber Blanket: 1 inch thick and 2 lb/cu. ft. nominal density.
4. Glass-Fiber Board: 1 inch thick and 2 lb/cu. ft. nominal density.
5. Glass-Fiber Pipe and Tank: 1 inch thick.
6. Mineral Wool Blanket: 1 inch thick and 4 lb/cu. ft. nominal density.
7. Mineral Wool Board: 1 inch thick and 4 lb/cu. ft. nominal density.
8. Mineral Wool Pipe and Tank: 1.5 inch thick.
9. Polyolefin: 1 inch thick.

3.12 INDOOR, FIELD-APPLIED JACKET SCHEDULE

A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.

B. If more than one material is listed, selection from materials listed is Contractor's option.

C. Equipment, Concealed:

1. None.
2. PVC, Color-Coded by System: 30 mils thick.
3. Aluminum, Corrugated: 0.016 inch thick.
4. Painted Aluminum, Smooth: 0.016 inch thick.
5. Stainless Steel, Type 304 or Type 316, Smooth No. 2B Finish: 0.010 inch thick.

D. Equipment, Exposed, up to **48 Inches** in Diameter or with Flat Surfaces of up to **72**

Inches:

1. None.
2. PVC, Color-Coded by System: 30 mils thick.
3. Aluminum, Corrugated: 0.016 inch thick.
4. Painted Aluminum, Smooth: 0.016 inch thick.
5. Stainless Steel, Type 304 or Type 316, Smooth No. 2B Finish: 0.010 inch thick.

E. Equipment, Exposed, Larger Than **48 Inches** in Diameter or with Flat Surfaces Larger Than **72 Inches**:

1. None.
2. Painted Aluminum, Smooth with 1-1/4-Inch- Deep Corrugations: 0.032 inch thick.
3. Stainless Steel, Type 304 or Type 316, Smooth, with 1-1/4-Inch- Deep Corrugations: 0.020 inch thick.

3.13 OUTDOOR, FIELD-APPLIED JACKET SCHEDULE

A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.

B. If more than one material is listed, selection from materials listed is Contractor's option.

C. Equipment, Concealed:

1. None.
2. PVC, Color-Coded by System: 30 mils thick.
3. Aluminum, Corrugated: 0.016 inch thick.
4. Painted Aluminum, Smooth: 0.016 inch thick.
5. Stainless Steel, Type 304 or Type 316, Smooth No. 2B Finish: 0.010 inch thick.

D. Equipment, Exposed, up to **48 Inches** in Diameter or with Flat Surfaces of up to **72 Inches**:

1. Painted Aluminum, Smooth: 0.016 inch thick.
2. Stainless Steel, Type 304 or Type 316, Smooth No. 2B Finish: 0.010 inch thick.

E. Equipment, Exposed, Larger Than **48 Inches** in Diameter or with Flat Surfaces Larger Than **72 Inches**:

1. Painted Aluminum, Smooth with 1-1/4-Inch- Deep Corrugations: 0.032 inch thick.
2. Stainless Steel, Type 304 Type 316, Smooth, with 1-1/4-Inch- Deep Corrugations: 0.020 inch thick.

END OF SECTION 22 07 16

SECTION 22 07 19 - PLUMBING PIPING INSULATION

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes insulating the following plumbing piping services:

1. Domestic cold-water piping.
2. Domestic hot-water piping.
3. Domestic recirculating hot-water piping.
4. Domestic chilled-water piping for drinking fountains.
5. Sanitary waste piping exposed to freezing conditions.
6. Storm-water piping exposed to freezing conditions.
7. Roof drains and rainwater leaders.
8. Supplies and drains for handicap-accessible lavatories and sinks.

B. Related Sections:

1. Section 220716 "Plumbing Equipment Insulation" for equipment insulation.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product. Include thermal conductivity, water-vapor permeance thickness, and jackets (both factory and field applied if any).

B. Sustainable Design Submittals:

C. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.

1. Detail application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.
2. Detail attachment and covering of heat tracing inside insulation.
3. Detail insulation application at pipe expansion joints for each type of insulation.
4. Detail insulation application at elbows, fittings, flanges, valves, and specialties for each type of insulation.
5. Detail removable insulation at piping specialties, equipment connections, and access panels.
6. Detail application of field-applied jackets.
7. Detail application at linkages of control devices.

D. Samples: For each type of insulation and jacket indicated. Identify each Sample, describing product and intended use. Sample sizes are as follows:

1. Preformed Pipe Insulation Materials: **12 inches** long by **NPS 2**.
2. Jacket Materials for Pipe: **12 inches** long by **NPS 2**.
3. Sheet Jacket Materials: **12 inches** square.

4. Manufacturer's Color Charts: For products where color is specified, show the full range of colors available for each type of finish material.

1.3 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified Installer.

B. Material Test Reports: From a qualified testing agency acceptable to authorities having jurisdiction indicating, interpreting, and certifying test results for compliance of insulation materials, sealers, attachments, cements, and jackets, with requirements indicated. Include dates of tests and test methods employed.

C. Field quality-control reports.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the Department of Labor, Bureau of Apprenticeship and Training.

B. Mockups: Before installing insulation, build mockups for each type of insulation and finish listed below to demonstrate quality of insulation application and finishes. Build mockups in the location indicated or, if not indicated, as directed by Architect. Use materials indicated for the completed Work.

1. Piping Mockups:

    a. One **10-foot** section of **NPS 2** straight pipe.
    b. One each of a 90-degree threaded, welded, and flanged elbow.
    c. One each of a threaded, welded, and flanged tee fitting.
    d. One **NPS 2** or smaller valve and one **NPS 2-1/2** or larger valve.
    e. Four support hangers, including hanger shield and insert.
    f. One threaded strainer and one flanged strainer with removable portion of insulation.
    g. One threaded reducer and one welded reducer.
    h. One pressure temperature tap.
    i. One mechanical coupling.
    j. One union.

2. For each mockup, fabricate cutaway sections to allow observation of application details for insulation materials, adhesives, mastics, attachments, and jackets.
3. Notify Architect seven days in advance of dates and times when mockups will be constructed.
4. Obtain Architect's approval of mockups before starting insulation application.
5. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
6. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.

7. Demolish and remove mockups when directed.

C. Comply with the following applicable standards and other requirements specified for miscellaneous components:

1. Supply and Drain Protective Shielding Guards: ICC A117.1.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Packaging: Insulation system materials are to be delivered to the Project site in unopened containers. The packaging is to include name of the manufacturer, fabricator, type, description, and size , as well as ASTM standard designation and maximum use temperature.

1.6 COORDINATION

A. Coordinate sizes and locations of supports, hangers, and insulation shields specified in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment."

B. Coordinate clearance requirements with piping Installer for piping insulation application. Before preparing piping Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.

C. Coordinate installation and testing of heat tracing.

1.7 SCHEDULING

A. Schedule insulation application after pressure testing systems and, where required, after installing and testing heat tracing. Insulation application may begin on segments that have satisfactory test results.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products in accordance with ASTM E84, by a testing agency acceptable to authorities having jurisdiction. Factory label insulation, jacket materials, adhesive, mastic, tapes, and cement material containers with appropriate markings of applicable testing agency.

1. All Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
2. All Insulation Installed Indoors; Outdoors-Installed Insulation in Contact with Airstream: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.

3. All Insulation Installed Indoors and Outdoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.

2.2 INSULATION MATERIALS

A. Comply with requirements in "Piping Insulation Schedule, General," "Indoor Piping Insulation Schedule," "Outdoor, Aboveground Piping Insulation Schedule," and "Outdoor, Underground Piping Insulation Schedule" articles for where insulating materials are applied.

B. Products do not contain asbestos, lead, mercury, or mercury compounds.

C. Products that come into contact with stainless steel have a leachable chloride content of less than 50 ppm when tested in accordance with ASTM C871.

D. Insulation materials for use on austenitic stainless steel are qualified as acceptable in accordance with ASTM C795.

E. Foam insulation materials do not use CFC or HCFC blowing agents in the manufacturing process.

F. Cellular Glass: Inorganic, incombustible, foamed or cellulated glass with annealed, rigid, hermetically sealed cells. Comply with ASTM C552.

1. Manufacturers: Subject to compliance with requirements, provide products by the following:

    a. Owens Corning

2. Preformed Pipe Insulation, Type II, Class 1: Unfaced.
3. Preformed Pipe Insulation, Type II, Class 2: With factory-applied ASJ jacket.
4. Fabricated shapes in accordance with ASTM C450, ASTM C585, and ASTM C1639.
5. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

G. Flexible Elastomeric: Closed-cell or expanded-rubber materials; suitable for maximum use temperature between **minus 70 deg F** and **220 deg F**. Comply with ASTM C534/C534M, Type I for tubular materials.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

    a. Aeroflex USA
    b. Armacell LLC
    c. K-Flex USA

H. Phenolic: Fabricated pipe insulation of rigid, expanded, closed-cell structure. Comply with ASTM C1126, Type III.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

    a. Polyguard Products, Inc.
    b. Resolco Inc.

2. Pre-fabricated Pipe Insulation: Type III , with factory-applied ASJ.
3. Fabricated shapes in accordance with ASTM C450 and ASTM C585.
4. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

2.3 Insulation Inserts

A. Basis-of-Design Product: Subject to compliance with requirements, provide insulation inserts or comparable product by one of the following:

1. Aeroflex USA

2.4 ADHESIVES

A. Materials are compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated unless otherwise indicated.

B. Cellular-Glass Adhesive: Two-component, thermosetting urethane adhesive containing no flammable solvents, with a service temperature range of **minus 100 to plus 200 deg F**.

1. Manufacturers: Subject to compliance with requirements, provide products by the following:

    a. Foster Brand; H. B. Fuller

2. Adhesive: As recommended by cellular glass manufacturer and with a VOC content of 80 g/L or less.
3. Adhesive shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
4. Adhesive shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
5. Adhesive shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers." Formaldehyde emissions shall not exceed 9 mcg/cu. m or 7 ppb, whichever is less.
6. Adhesive shall comply with the testing and product requirements of the California

Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

7. Adhesive shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers." The building concentration of formaldehyde shall not exceed half of the indoor recommended exposure limit or 33 mcg/cu. m and that of acetaldehyde shall not exceed 9 mcg/cu. m.

C. Flexible Elastomeric and Polyolefin Adhesive: Solvent-based adhesive.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

   a. Aeroflex USA
   b. Armacell LLC
   c. Foster Brand; H. B. Fuller
   d. K-Flex USA

2. Adhesive: As recommended by flexible elastomeric and polyolefin manufacturer and with a VOC content of 80 g/L or less.
3. Adhesive shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
4. Adhesive shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
5. Adhesive shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers." Formaldehyde emissions shall not exceed 9 mcg/cu. m or 7 ppb, whichever is less.
6. Adhesive shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
7. Adhesive shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers." The building concentration of formaldehyde shall not exceed half of the indoor recommended exposure limit or 33 mcg/cu. m and that of acetaldehyde shall not exceed 9 mcg/cu. m.
8. Flame-spread index is 25 or less and smoke-developed index is 50 or less as tested in accordance with ASTM E84.
9. Wet Flash Point: Below **0 deg F**.
10. Service Temperature Range: **40 to 200 deg F**.
11. Color: Black.

D. Phenolic Adhesive: Solvent-based resin adhesive, with a service temperature range of **minus 75 to plus 300 deg F**.

1. Manufacturers: Subject to compliance with requirements, provide products by the following:

    a. Childers Brand; H. B. Fuller Construction Products
    b. Foster Brand; H. B. Fuller

2. Adhesive: As recommended by phenolic manufacturer and with a VOC content of 50 g/L or less.
3. Adhesives and sealants shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
4. Adhesives and sealants shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
5. Adhesives and sealants shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers." Formaldehyde emissions shall not exceed 9 mcg/cu. m or 7 ppb, whichever is less.
6. Adhesives and sealants shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
7. Adhesives and sealants shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers." The building concentration of formaldehyde shall not exceed half of the indoor recommended exposure limit, or 33 mcg/cu. m, and that of acetaldehyde shall not exceed 9 mcg/cu. m.

E. ASJ Adhesive and FSK Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A, for bonding insulation jacket lap seams and joints.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

    a. Childers Brand; H. B. Fuller Construction Products
    b. Foster Brand; H. B. Fuller
    c. Mon-Eco Industries, Inc.

2. Adhesives shall have a VOC content of 80 g/L or less.
3. Adhesives and sealants shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

4. Adhesives and sealants shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
5. Adhesives and sealants shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers." Formaldehyde emissions shall not exceed 9 mcg/cu. m or 7 ppb, whichever is less.
6. Adhesives and sealants shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
7. Adhesives and sealants shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers." The building concentration of formaldehyde shall not exceed half of the indoor recommended exposure limit, or 33 mcg/cu. m, and that of acetaldehyde shall not exceed 9 mcg/cu. m.

2.5 MASTICS AND COATINGS

A. Materials are compatible with insulation materials, jackets, and substrates.

1. Mastics: As recommended by insulation manufacturer and with a VOC content of 50 g/L or less.
2. Mastics shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
3. Mastics shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
4. Mastics shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers." Formaldehyde emissions shall not exceed 9 mcg/cu. m or 7 ppb, whichever is less.
5. Mastics shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
6. Mastics shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers." The building concentration of formaldehyde shall not exceed half of the indoor recommended exposure limit, or 33 mcg/cu. m, and that of acetaldehyde shall not exceed 9 mcg/cu. m.

B. Vapor-Retarder Mastic, Solvent Based, Indoor Use: Suitable for indoor use on below-ambient services.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

   a. Childers Brand; H. B. Fuller Construction Products
   b. Foster Brand; H. B. Fuller
   c. Mon-Eco Industries, Inc.

2. Water-Vapor Permeance: Comply with ASTM E96/E96M or ASTM F1249.
3. Service Temperature Range: **0 to 180 deg F**.
4. Color: White.

C. Breather Mastic: Water based; suitable for indoor and outdoor use on above-ambient services.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

   a. Childers Brand; H. B. Fuller Construction Products
   b. Foster Brand; H. B. Fuller
   c. Knauf Insulation
   d. Mon-Eco Industries, Inc.
   e. Vimasco Corporation

2. Water-Vapor Permeance: ASTM E96/E96M, greater than **1.0 perm** at manufacturer's recommended dry film thickness.
3. Service Temperature Range: 0 to plus 180 deg F.
4. Color: White.

2.6 LAGGING ADHESIVES

A. Lagging Adhesives: Adhesives comply with MIL-A-3316C, Class I, Grade A, and are compatible with insulation materials, jackets, and substrates.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

   a. Childers Brand; H. B. Fuller Construction Products
   b. Foster Brand; H. B. Fuller
   c. Vimasco Corporation

2. Adhesive shall be as recommended by insulation manufacturer and shall have a VOC content of 50 g/L or less.
3. Adhesive shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation

of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

4. Adhesive shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
5. Adhesive shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers." Formaldehyde emissions shall not exceed 9 mcg/cu. m or 7 ppb, whichever is less.
6. Adhesive shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
7. Adhesive shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers." The building concentration of formaldehyde shall not exceed half of the indoor recommended exposure limit, or 33 mcg/cu. m, and that of acetaldehyde shall not exceed 9 mcg/cu. m.
8. Fire-resistant, water-based lagging adhesive and coating for use indoors to adhere fire-resistant lagging cloths over pipe insulation.
9. Service Temperature Range: 0 to plus 180 deg F.
10. Color: White.

2.7 SEALANTS

A. Materials are as recommended by the insulation manufacturer and are compatible with insulation materials, jackets, and substrates.

B. Joint Sealants:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

    a. Childers Brand; H. B. Fuller Construction Products
    b. Foster Brand; H. B. Fuller
    c. Mon-Eco Industries, Inc.
    d. Owens Corning

2. Permanently flexible, elastomeric sealant.
3. Service Temperature Range: Minus 58 to plus 176 deg F.
4. Color: White or gray.
5. Sealant shall have a VOC content of 420 g/L or less.
6. Sealant shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

7. Sealant shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
8. Sealant shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers." Formaldehyde emissions shall not exceed 9 mcg/cu. m or 7 ppb, whichever is less.
9. Sealant shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
10. Sealant shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers." The building concentration of formaldehyde shall not exceed half of the indoor recommended exposure limit, or 33 mcg/cu. m, and that of acetaldehyde shall not exceed 9 mcg/cu. m.

C. ASJ Flashing Sealants and PVC Jacket Flashing Sealants:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

    a. Childers Brand; H. B. Fuller Construction Products
    b. Foster Brand; H. B. Fuller

2. Fire- and water-resistant, flexible, elastomeric sealant.
3. Service Temperature Range: **Minus 40 to plus 250 deg F**.
4. Color: White.
5. Sealant shall have a VOC content of 420 g/L or less.
6. Sealant shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
7. Sealant shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
8. Sealant shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers." Formaldehyde emissions shall not exceed 9 mcg/cu. m or 7 ppb, whichever is less.
9. Sealant shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
10. Sealant shall comply with the testing and product requirements of the California

Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers." The building concentration of formaldehyde shall not exceed half of the indoor recommended exposure limit, or 33 mcg/cu. m, and that of acetaldehyde shall not exceed 9 mcg/cu. m.

2.8 FACTORY-APPLIED JACKETS

A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:

1. ASJ: White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C1136, Type I.
2. ASJ-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C1136, Type I.
3. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C1136, Type II.
4. ASJ+: Aluminum foil reinforced with glass scrim bonded to a kraft paper interleaving with an outer film leaving no paper exposed; complying with ASTM C1136 Types I, II, III, IV, and VII.
5. PSK Jacket: Aluminum foil fiberglass reinforced scrim with polyethylene backing, complying with ASTM C1136, Type II.

2.9 FIELD-APPLIED JACKETS

A. Field-applied jackets comply with ASTM C1136, Type I, unless otherwise indicated.

B. FSK Jacket: Aluminum-foil-face, fiberglass-reinforced scrim with kraft-paper backing.

C. Metal Jacket:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

   a. Johns Manville; a Berkshire Hathaway company
   b. RPR Products, Inc.

2. Aluminum Jacket: Comply with **ASTM B209**, Alloy 3003, 3005, 3105, or 5005, Temper H-14.

   a. Sheet and roll stock ready for shop or field sizing.
   b. Finish and thickness are indicated in field-applied jacket schedules.
   c. Moisture Barrier for Indoor Applications: 3-mil- thick, heat-bonded polyethylene and kraft paper.
   d. Moisture Barrier for Outdoor Applications: 3-mil- thick, heat-bonded polyethylene and kraft paper.
   e. Factory-Fabricated Fitting Covers:

1) Same material, finish, and thickness as jacket.
2) Preformed two-piece or gore, 45- and 90-degree, short- and long-radius elbows.
3) Tee covers.
4) Flange and union covers.
5) End caps.
6) Beveled collars.
7) Valve covers.
8) Field fabricate fitting covers only if factory-fabricated fitting covers are not available.

3. Stainless Steel Jacket: ASTM A240/A240M.

a. Sheet and roll stock ready for shop or field sizing.
b. Material, finish, and thickness are indicated in field-applied jacket schedules.
c. Moisture Barrier for Indoor Applications: 3-mil- thick, heat-bonded polyethylene and kraft paper.
d. Moisture Barrier for Outdoor Applications: 3-mil- thick, heat-bonded polyethylene and kraft paper.
e. Factory-Fabricated Fitting Covers:

1) Same material, finish, and thickness as jacket.
2) Preformed two-piece or gore, 45- and 90-degree, short- and long-radius elbows.
3) Tee covers.
4) Flange and union covers.
5) End caps.
6) Beveled collars.
7) Valve covers.
8) Field fabricate fitting covers only if factory-fabricated fitting covers are not available.

2.10 TAPES

A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C1136.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. 3M Industrial Adhesives and Tapes Division
b. Aeroflex USA
c. Avery Dennison Corporation, Specialty Tapes Division
d. Ideal Tape Co., Inc., an American Biltrite Company
e. Knauf Insulation

2. Width: 3 inches.
3. Thickness: 11.5 mils.

4. Adhesion: 90 ounces force/inch in width.
5. Elongation: 2 percent.
6. Tensile Strength: 40 lbf/inch in width.
7. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.

B. FSK Tape: Foil-face, vapor-retarder tape matching factory-applied jacket with acrylic adhesive; complying with ASTM C1136.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

    a. 3M Industrial Adhesives and Tapes Division
    b. Avery Dennison Corporation, Specialty Tapes Division
    c. Ideal Tape Co., Inc., an American Biltrite Company
    d. Knauf Insulation

2. Basis-of-Design Product: Subject to compliance with requirements, provide tape or comparable product by one of the following:

    a. 3M Industrial Adhesives and Tapes Division
    b. Avery Dennison Corporation, Specialty Tapes Division
    c. Ideal Tape Co., Inc., an American Biltrite Company
    d. Knauf Insulation

3. Width: 3 inches.
4. Thickness: 6.5 mils.
5. Adhesion: 90 ounces force/inch in width.
6. Elongation: 2 percent.
7. Tensile Strength: 40 lbf/inch in width.
8. FSK Tape Disks and Squares: Precut disks or squares of FSK tape.

C. Aluminum-Foil Tape: Vapor-retarder tape with acrylic adhesive.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

    a. 3M Industrial Adhesives and Tapes Division
    b. Avery Dennison Corporation, Specialty Tapes Division
    c. Ideal Tape Co., Inc., an American Biltrite Company
    d. Knauf Insulation

2. Width: 2 inches.
3. Thickness: 3.7 mils.
4. Adhesion: 100 ounces force/inch in width.
5. Elongation: 5 percent.
6. Tensile Strength: 34 lbf/inch in width.

2.11 SECUREMENTS

A. Bands:

1. Manufacturers: Subject to compliance with requirements, provide products by the following:

    a. Johns Manville; a Berkshire Hathaway company
    b. RPR Products, Inc.

2. Stainless Steel: ASTM A240/A240M, Type 304 or Type 316; **0.015 inch** thick, 3/4 inch wide with wing seal or closed seal.
3. Aluminum: **ASTM B209**, Alloy 3003, 3005, 3105, or 5005; Temper H-14, **0.020 inch** thick, 3/4 inch wide with wing seal or closed seal.

B. Staples: Outward-clinching insulation staples, nominal **3/4-inch-** wide, stainless steel or Monel.

C. Wire: 0.080-inch nickel-copper alloy.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

    a. C & F Wire Products
    b. Johns Manville; a Berkshire Hathaway company
    c. RPR Products, Inc.

2.12 PROTECTIVE SHIELDING GUARDS

A. Protective Shielding Pipe Covers:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

    a. Buckaroos, Inc.
    b. McGuire Manufacturing
    c. MVG Molded Products
    d. Plumberex Specialty Products, Inc.
    e. ProFlo; a Ferguson Enterprises, Inc. brand
    f. Truebro; IPS Corporation
    g. Zurn Industries, LLC

2. Description: Manufactured plastic wraps for covering plumbing fixture hot- and cold-water supplies and trap and drain piping. Comply with Americans with Disabilities Act (ADA) requirements.

B. Protective Shielding Piping Enclosures:

1. Manufacturers: Subject to compliance with requirements, provide products by the

following:

a. ProFlo; a Ferguson Enterprises, Inc. brand
b. Truebro; IPS Corporation
c. Zurn Industries, LLC

2. Description: Manufactured plastic enclosure for covering plumbing fixture hot- and cold-water supplies and trap and drain piping. Comply with ADA requirements.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of insulation application.

1. Verify that systems to be insulated have been tested and are free of defects.
2. Verify that surfaces to be insulated are clean and dry.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.

B. Clean and prepare surfaces to be insulated. Before insulating, apply a corrosion coating to insulated surfaces as follows:

1. Stainless Steel: Coat 300 series stainless steel with an epoxy primer **5 mils** thick and an epoxy finish **5 mils** thick if operating in a temperature range of between **140 and 300 deg F**. Consult coating manufacturer for appropriate coating materials and application methods for operating temperature range.
2. Carbon Steel: Coat carbon steel operating at a service temperature of between **32 and 300 deg F** with an epoxy coating. Consult coating manufacturer for appropriate coating materials and application methods for operating temperature range.

C. Coordinate insulation installation with the tradesman installing heat tracing. Comply with requirements for heat tracing that apply to insulation.

D. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless steel surfaces, use demineralized water.

3.3 GENERAL INSTALLATION REQUIREMENTS

A. Install insulation materials, accessories, and finishes with smooth, straight, and even

surfaces; free of voids throughout the length of piping, including fittings, valves, and specialties.

B. Install insulation materials, forms, vapor barriers or retarders, jackets, and of thicknesses required for each item of pipe system, as specified in insulation system schedules.

C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, compress, or otherwise damage insulation or jacket.

D. Install insulation with longitudinal seams at top and bottom (12 o'clock and 6 o'clock positions) of horizontal runs.

E. Install multiple layers of insulation with longitudinal and end seams staggered.

F. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.

G. Keep insulation materials dry during storage, application, and finishing. Replace insulation materials that get wet during storage or in the installation process before being properly covered and sealed in accordance with Contract Documents , unless otherwise approved by the engineer-of-record.

H. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.

I. Install insulation with least number of joints practical.

J. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.

1. Install insulation continuously through hangers and around anchor attachments.
2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends attached to structure with vapor-barrier mastic.
3. Install insert materials and insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.

K. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.

L. Install insulation with factory-applied jackets as follows:

1. Draw jacket tight and smooth, but not to the extent of creating wrinkles or areas of compression in the insulation.
2. Cover circumferential joints with **3-inch-** wide strips, of same material as

insulation jacket. Secure strips with adhesive and outward-clinching staples along both edges of strip, spaced **4 inches** o.c.

3. Overlap jacket longitudinal seams at least **1-1/2 inches**. Install insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward-clinching staples along edge at **4 inches** o.c.

    a. For below-ambient services, apply vapor-barrier mastic over staples.

4. Cover joints and seams with tape, in accordance with insulation material manufacturer's written instructions, to maintain vapor seal.
5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to pipe flanges and fittings.

M. Cut insulation in a manner to avoid compressing insulation.

N. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.

O. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches in similar fashion to butt joints.

P. For above-ambient services, do not install insulation to the following:

1. Vibration-control devices.
2. Testing agency labels and stamps.
3. Nameplates and data plates.
4. Cleanouts.

3.4 PENETRATIONS

A. Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetrations.

1. Seal penetrations with flashing sealant.
2. For applications requiring only indoor insulation, terminate insulation above roof surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
3. Extend jacket of outdoor insulation outside roof flashing at least **2 inches** below top of roof flashing.
4. Seal jacket to roof flashing with flashing sealant.

B. Insulation Installation at Underground Exterior Wall Penetrations: Terminate insulation flush with sleeve seal. Seal terminations with flashing sealant.

C. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.

1. Seal penetrations with flashing sealant.
2. For applications requiring only indoor insulation, terminate insulation inside wall surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
3. Extend jacket of outdoor insulation outside wall flashing and overlap wall flashing at least **2 inches**.
4. Seal jacket to wall flashing with flashing sealant.

D. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.

E. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Install insulation continuously through penetrations of fire-rated walls and partitions.

1. Comply with requirements in Section 078413 "Penetration Firestopping" for firestopping and fire-resistive joint sealers.

F. Insulation Installation at Floor Penetrations:

1. Pipe: Install insulation continuously through floor penetrations.
2. Seal penetrations through fire-rated assemblies. Comply with requirements in Section 078413 "Penetration Firestopping."

3.5 GENERAL PIPE INSULATION INSTALLATION

A. Requirements in this article generally apply to all insulation materials, except where more specific requirements are specified in various pipe insulation material installation articles below.

B. Insulation Installation on Fittings, Valves, Strainers, Flanges, Mechanical Couplings, and Unions:

1. Install insulation over fittings, valves, strainers, flanges, mechanical couplings, unions, and other specialties with continuous thermal and vapor-retarder integrity unless otherwise indicated.
2. Insulate pipe elbows using preformed fitting insulation or mitered or routed fittings made from same material and density as that of adjacent pipe insulation. Each piece is butted tightly against adjoining piece and bonded with adhesive. Fill joints, seams, voids, and irregular surfaces with insulating cement finished to a smooth, hard, and uniform contour that is uniform with adjoining pipe insulation.
3. Insulate tee fittings with preformed fitting insulation or sectional pipe insulation of same material and thickness as that used for adjacent pipe. Cut sectional pipe insulation to fit. Butt each section closely to the next and hold in place with tie wire. Bond pieces with adhesive.
4. Insulate valves using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as that used for adjacent pipe. Overlap adjoining pipe insulation by not less than 2 times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. For valves, insulate up to and including the bonnets, valve stuffing-box studs, bolts, and nuts. Fill joints, seams,

and irregular surfaces with insulating cement.

5. Insulate strainers using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than 2 times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Fill joints, seams, and irregular surfaces with insulating cement. Insulate strainers, so strainer basket flange or plug can be easily removed and replaced without damaging the insulation and jacket. Provide a removable reusable insulation cover. For below-ambient services, provide a design that maintains vapor barrier.
6. Insulate flanges, mechanical couplings, and unions, using a section of oversized preformed pipe insulation. Overlap adjoining pipe insulation by not less than 2 times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Stencil or label the outside insulation jacket of each union with the word "union" matching size and color of pipe labels.
7. Cover segmented insulated surfaces with a layer of finishing cement and coat with a mastic. Install vapor-barrier mastic for below-ambient services and a breather mastic for above-ambient services. Reinforce the mastic with fabric-reinforcing mesh. Trowel the mastic to a smooth and well-shaped contour.
8. For services not specified to receive a field-applied jacket, except for flexible elastomeric and polyolefin, install fitted PVC cover over elbows, tees, strainers, valves, flanges, and unions. Terminate ends with PVC end caps. Tape PVC covers to adjoining insulation facing, using PVC tape.

C. Insulate instrument connections for thermometers, pressure gages, pressure temperature taps, test connections, flow meters, sensors, switches, and transmitters on insulated pipes. Shape insulation at these connections by tapering it to and around the connection with insulating cement and finish with finishing cement, mastic, and flashing sealant.

D. Install removable insulation covers at locations indicated. Installation conforms to the following:

1. Make removable flange and union insulation from sectional pipe insulation of same thickness as that on adjoining pipe. Install same insulation jacket as that of adjoining pipe insulation.
2. When flange and union covers are made from sectional pipe insulation, extend insulation from flanges or union at least 2 times the insulation thickness over adjacent pipe insulation on each side of flange or union. Secure flange cover in place with stainless steel or aluminum bands. Select band material compatible with insulation and jacket.
3. Construct removable valve insulation covers in same manner as for flanges, except divide the two-part section on the vertical center line of valve body.
4. When covers are made from block insulation, make two halves, each consisting of mitered blocks wired to stainless steel fabric. Secure this wire frame, with its attached insulation, to flanges with tie wire. Extend insulation at least **2 inches** over adjacent pipe insulation on each side of valve. Fill space between flange or union cover and pipe insulation with insulating cement. Finish cover assembly with insulating cement applied in two coats. After first coat is dry, apply and trowel second coat to a smooth finish.
5. Unless a PVC jacket is indicated in field-applied jacket schedules, finish exposed surfaces with a metal jacket.

3.6 INSTALLATION OF CELLULAR-GLASS INSULATION

A. Insulation Installation on Straight Pipes and Tubes:

1. Secure each layer of insulation to pipe with wire or bands, and tighten bands without deforming insulation materials.
2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
3. For insulation with jackets on above-ambient services, secure laps with outward-clinched staples at **6 inches** o.c.
4. For insulation with jackets on below-ambient services, do not staple longitudinal tabs. Instead, secure tabs with additional adhesive, as recommended by insulation material manufacturer, and seal with vapor-barrier mastic and flashing sealant.

B. Insulation Installation on Pipe Flanges:

1. Install prefabricated pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of cellular-glass block insulation of same thickness as that of pipe insulation. Where voids are difficult to fill with block insulation, fill the voids with a fibrous insulation material suitable for the specific operating temperature.
4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least **1 inch**, and seal joints with flashing sealant.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install prefabricated sections of same material as that of straight segments of pipe insulation when available. Secure according to manufacturer's written instructions.
2. When preformed sections of insulation are not available, install mitered or routed sections of cellular-glass insulation. Secure insulation materials with wire or bands.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install prefabricated sections of cellular-glass insulation to valve body.
2. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
3. Install insulation to flanges as specified for flange insulation application.

3.7 INSTALLATION OF FLEXIBLE ELASTOMERIC INSULATION

A. Seal longitudinal seams and end joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

B. Insulation Installation on Pipe Flanges:

1. Install pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of sheet insulation of same thickness as that of pipe insulation.
4. Secure insulation to flanges and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install sections of pipe insulation and miter if required in accordance with manufacturer's written instructions.
2. Secure insulation materials and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install prefabricated valve covers manufactured of same material as that of pipe insulation when available.
2. When prefabricated valve covers are not available, install cut sections of pipe and sheet insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
3. Install insulation to flanges as specified for flange insulation application.
4. Secure insulation to valves and specialties, and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

3.8 INSTALLATION OF GLASS-FIBER AND MINERAL WOOL INSULATION

A. Insulation Installation on Straight Pipes and Tubes:

1. Secure each layer of preformed pipe insulation to pipe with wire or bands, and tighten bands without deforming insulation materials.
2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
3. For insulation with jackets on above-ambient surfaces, secure laps with outward-clinched staples at **6 inches** o.c.
4. For insulation with jackets on below-ambient surfaces, do not staple longitudinal tabs. Instead, secure tabs with additional adhesive, as recommended by insulation material manufacturer, and seal with vapor-barrier mastic and flashing sealant.

B. Insulation Installation on Pipe Flanges:

1. Install prefabricated pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.

3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with glass-fiber or mineral-wool blanket insulation.
4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least **1 inch**, and seal joints with flashing sealant.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install prefabricated sections of same material as that of straight segments of pipe insulation when available.
2. When prefabricated insulation elbows and fittings are not available, install mitered sections of pipe insulation, to a thickness equal to adjoining pipe insulation. Secure insulation materials with wire or bands.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install prefabricated sections of same material as that of straight segments of pipe insulation when available.
2. When prefabricated sections are not available, install fabricated sections of pipe insulation to valve body.
3. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
4. Install insulation to flanges as specified for flange insulation application.

3.9 INSTALLATION OF PHENOLIC INSULATION

A. General Installation Requirements:

1. Secure single-layer insulation with stainless steel bands at **12-inch** intervals, and tighten bands without deforming insulation materials.
2. Install two-layer insulation with joints tightly butted and staggered at least **3 inches**. Secure inner layer with **0.062-inch** wire spaced at **12-inch** intervals. Secure outer layer with stainless steel bands at **12-inch** intervals.

B. Insulation Installation on Straight Pipes and Tubes:

1. Secure each layer of insulation to pipe with wire or bands, and tighten bands without deforming insulation materials.
2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
3. For insulation with jackets on above-ambient services, secure laps with outward-clinched staples at **6 inches** o.c.
4. For insulation with jackets with vapor retarders on below-ambient services, do not staple longitudinal tabs. Instead, secure tabs with additional adhesive, as recommended by insulation material manufacturer, and seal with vapor-barrier mastic and flashing sealant.

C. Insulation Installation on Pipe Flanges:

1. Install prefabricated pipe insulation to outer diameter of pipe flange.

2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of block insulation of same material and thickness as that of pipe insulation. Where voids are difficult to fill with block insulation, fill the voids with a fibrous insulation material suitable for the specific operating temperature.

D. Insulation Installation on Pipe Fittings and Elbows:

1. Install preformed insulation sections of same material as that of straight segments of pipe insulation. Secure according to manufacturer's written instructions.

E. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed insulation sections of same material as that of straight segments of pipe insulation. Secure according to manufacturer's written instructions.
2. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
3. Install insulation to flanges as specified for flange insulation application.

3.10 INSTALLATION OF POLYOLEFIN INSULATION

A. Insulation Installation on Straight Pipes and Tubes:

1. Seal split-tube longitudinal seams and end joints with manufacturer's recommended adhesive , or via self-seal mechanism to eliminate openings in insulation that allow passage of air to surface being insulated.

B. Insulation Installation on Pipe Flanges:

1. Install pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of polyolefin sheet insulation of same thickness as that of pipe insulation.
4. Secure insulation to flanges and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install mitered sections of polyolefin pipe insulation.
2. Secure insulation materials and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install cut sections of polyolefin pipe and sheet insulation to valve body.
2. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
3. Install insulation to flanges as specified for flange insulation application.
4. Secure insulation to valves and specialties, and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

3.11 INSTALLATION OF FIELD-APPLIED JACKETS

A. Where glass-cloth jackets are indicated, install directly over bare insulation or insulation with factory-applied jackets.

1. Draw jacket smooth and tight to surface with **2-inch** overlap at seams and joints.
2. Embed glass cloth between two **0.062-inch-** thick coats of lagging adhesive.
3. Completely encapsulate insulation with coating, leaving no exposed insulation.

B. Where FSK jackets are indicated, install as follows:

1. Draw jacket material smooth and tight.
2. Install lap or joint strips with same material as jacket.
3. Secure jacket to insulation with manufacturer's recommended adhesive.
4. Install jacket with **1-1/2-inch** laps at longitudinal seams and **3-inch-** wide joint strips at end joints.
5. Seal openings, punctures, and breaks in vapor-retarder jackets and exposed insulation with vapor-barrier mastic.

C. Where PVC jackets are indicated, install with **1-inch** overlap at longitudinal seams and end joints. Seal with manufacturer's recommended adhesive.

1. Apply two continuous beads of adhesive to seams and joints, one bead under lap and the finish bead along seam and joint edge.

D. Where metal jackets are indicated, install with **2-inch** overlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal end joints with weatherproof sealant recommended by insulation manufacturer. Secure jacket with stainless steel bands **12 inches** o.c. and at end joints.

3.12 FINISHES

A. Insulation with ASJ, Glass-Cloth, or Other Paintable Jacket Material: Paint jacket with paint system identified below and as specified in Section 099113 "Exterior Painting" and Section 099123 "Interior Painting."

1. Flat Acrylic Finish: Two finish coats over a primer that is compatible with jacket material and finish coat paint. Add fungicidal agent to render fabric mildew proof.

a. Finish Coat Material: Interior, flat, latex-emulsion size.

B. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of insulation manufacturer's recommended protective coating.

C. Color: Final color as selected by Architect. Vary first and second coats to allow visual inspection of the completed Work.

D. Do not field paint aluminum or stainless steel jackets.

3.13 FIELD QUALITY CONTROL

A. Owner will engage a qualified testing agency to perform tests and inspections.

B. Engage a qualified testing agency to perform tests and inspections.

C. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

D. Perform tests and inspections .

E. Tests and Inspections: Inspect pipe, fittings, strainers, and valves, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection is limited to three locations of straight pipe, three locations of threaded fittings, three locations of welded fittings, two locations of threaded strainers, two locations of welded strainers, three locations of threaded valves, and three locations of flanged valves for each pipe service defined in the "Piping Insulation Schedule, General" Article.

F. All insulation applications will be considered defective if they do not pass tests and inspections.

G. Prepare test and inspection reports.

3.14 PIPING INSULATION SCHEDULE, GENERAL

A. Acceptable preformed pipe and tubular insulation materials and thicknesses are identified for each piping system and pipe size range. If more than one material is listed for a piping system, selection from materials listed is Contractor's option.

B. Items Not Insulated: Unless otherwise indicated, do not install insulation on the following:

1. Drainage piping located in crawl spaces.
2. Underground piping.
3. Chrome-plated pipes and fittings unless there is a potential for personnel injury.

3.15 INDOOR PIPING INSULATION SCHEDULE

A. Domestic Cold Water:

1. NPS 1 (DN 25) and Smaller: Insulation is one of the following:

   a. Cellular Glass: 1-1/2 inches thick.
   b. Flexible Elastomeric: 1/2 inch thick.
   c. Glass-Fiber, Preformed Pipe Insulation, Type I: 1/2 inch thick.
   d. Mineral Wool, Preformed Pipe Insulation, Type II: 1/2 inch thick.
   e. Phenolic: 1 inch thick.
   f. Polyolefin: 1/2 inch thick.

2. NPS 1-1/4 and Larger: Insulation is one of the following:

   a. Cellular Glass: 1-1/2 inches thick.
   b. Flexible Elastomeric: 1 inch thick.
   c. Glass-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.
   d. Mineral Wool, Preformed Pipe Insulation, Type II: 1 inch thick.
   e. Phenolic: 1 inch thick.
   f. Polyolefin: 1 inch thick.

B. Domestic Hot and Recirculated Hot Water:

1. NPS 1-1/4 and Smaller: Insulation is one of the following:

   a. Cellular Glass: 1-1/2 inches thick.
   b. Flexible Elastomeric: 3/4 inch thick.
   c. Glass-Fiber, Preformed Pipe Insulation, Type I: 1/2 inch thick.
   d. Mineral Wool, Preformed Pipe Insulation, Type II: 1/2 inch thick.
   e. Phenolic: 1 inch thick.
   f. Polyolefin: 3/4 inch thick.

2. NPS 1-1/2 and Larger: Insulation is one of the following:

   a. Cellular Glass: 1-1/2 inches thick.
   b. Flexible Elastomeric: 1 inch thick.
   c. Glass-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.
   d. Mineral Wool, Preformed Pipe Insulation, Type II: 1 inch thick.
   e. Phenolic: 1 inch thick.
   f. Polyolefin: 1 inch thick.

C. Domestic Chilled Water (Potable):

1. All Pipe Sizes: Insulation is one of the following:

   a. Cellular Glass: 1-1/2 inches thick.
   b. Flexible Elastomeric: 1 inch thick.
   c. Glass-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.
   d. Mineral Wool, Preformed Pipe Insulation, Type II: 1 inch thick.
   e. Phenolic: 1 inch thick.

f. Polyolefin: 1 inch thick.

D. Stormwater and Overflow:

1. All Pipe Sizes: Insulation is one of the following:

a. Cellular Glass: 1-1/2 inches thick.
b. Flexible Elastomeric: 1 inch thick.
c. Glass-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.
d. Mineral Wool, Preformed Pipe Insulation, Type II: 1 inch thick.
e. Phenolic: 1 inch thick.
f. Polyolefin: 1 inch thick.

E. Roof Drain and Overflow Drain Bodies:

1. All Pipe Sizes: Insulation is one of the following:

a. Cellular Glass: 1-1/2 inches thick.
b. Flexible Elastomeric: 1 inch thick.
c. Glass-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.
d. Mineral Wool, Preformed Pipe Insulation, Type II: 1 inch thick.
e. Phenolic: 1 inch thick.
f. Polyolefin: 1 inch thick.

F. Exposed Sanitary Drains, Domestic Water, Domestic Hot Water, and Stops for Plumbing Fixtures for People with Disabilities:

1. All Pipe Sizes: Insulation is one of the following:

a. Flexible Elastomeric: 1/2 inch thick.
b. Glass-Fiber, Preformed Pipe Insulation, Type I: 1/2 inch thick.
c. Mineral Wool, Preformed Pipe Insulation, Type II: 1/2 inch thick.
d. Polyolefin: 1/2 inch thick.

G. Sanitary Waste Piping Where Heat Tracing Is Installed:

1. All Pipe Sizes: Insulation is one of the following:

a. Cellular Glass: 2 inches thick.
b. Glass-Fiber, Preformed Pipe Insulation, Type I: 1-1/2 inches thick.
c. Mineral Wool, Preformed Pipe Insulation, Type II: 1-1/2 inches thick.
d. Phenolic: 1-1/2 inches thick.

H. Floor Drains, Traps, and Sanitary Drain Piping within 10 Feet (3 m) of Drain Receiving Condensate and Equipment Drain Water below 60 Deg F (16 Deg C):

1. All Pipe Sizes: Insulation is one of the following:

a. Cellular Glass: 1-1/2 inches thick.
b. Flexible Elastomeric: 3/4 inch thick.
c. Glass-Fiber, Preformed Pipe Insulation, Type I: 1/2 inch thick.

d. Mineral Wool, Preformed Pipe Insulation, Type II: 1/2 inch thick.
e. Phenolic: 1 inch thick.
f. Polyolefin: 3/4 inch thick.

I. Hot Service Drains:

1. All Pipe Sizes: Insulation is one of the following:

a. Cellular Glass: 1-1/2 inches thick.
b. Glass-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.
c. Mineral Wool, Preformed Pipe Insulation, Type II: 1 inch thick.

J. Hot Service Vents:

1. All Pipe Sizes: Insulation is one of the following:

a. Cellular Glass: 1-1/2 inches thick.
b. Glass-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.
c. Mineral Wool, Preformed Pipe Insulation, Type II: 1 inch thick.

3.16 OUTDOOR, ABOVEGROUND PIPING INSULATION SCHEDULE

A. Domestic Water Piping:

1. All Pipe Sizes: Insulation is one of the following:

a. Cellular Glass: 2 inches thick.
b. Flexible Elastomeric: 2 inches thick.
c. Glass-Fiber, Preformed Pipe Insulation, Type I: 2 inches thick.
d. Mineral Wool, Preformed Pipe Insulation, Type II: 2 inches thick.
e. Phenolic: 2 inches thick.
f. Polyolefin: 2 inches thick.

B. Domestic Hot and Recirculated Hot Water:

1. All Pipe Sizes: Insulation is one of the following:

a. Cellular Glass: 2 inches thick.
b. Flexible Elastomeric: 2 inches thick.
c. Glass-Fiber, Preformed Pipe Insulation, Type I: 2 inches thick.
d. Mineral Wool, Preformed Pipe Insulation, Type II: 2 inches thick.
e. Phenolic: 2 inches thick.
f. Polyolefin: 2 inches thick.

C. Sanitary Waste Piping Where Heat Tracing Is Installed:

1. All Pipe Sizes: Insulation is one of the following:

a. Cellular Glass: 2 inches thick.
b. Glass-Fiber, Preformed Pipe Insulation, Type I: 2 inches thick.
c. Mineral Wool, Preformed Pipe Insulation, Type II: 2 inches thick.

d. Phenolic: 2 inches thick.

D. Hot Service Drains:

1. All Pipe Sizes: Insulation is one of the following:

a. Cellular Glass: 1-1/2 inches thick.
b. Glass-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.
c. Mineral Wool, Preformed Pipe Insulation, Type II: 1 inch thick.

E. Hot Service Vents:

1. All Pipe Sizes: Insulation is one of the following:

a. Cellular Glass: 1-1/2 inches thick.
b. Glass-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.
c. Mineral Wool, Preformed Pipe Insulation, Type II: 1 inch thick.

3.17 OUTDOOR, UNDERGROUND PIPING INSULATION SCHEDULE

A. Sanitary Waste Piping, All Sizes, Where Heat Tracing Is Installed: Cellular glass, 2 inches thick.

B. Chilled Water, All Sizes: Cellular glass, 2 inches thick.

3.18 INDOOR, FIELD-APPLIED JACKET SCHEDULE

A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.

B. If more than one material is listed, selection from materials listed is Contractor's option.

C. Piping, Concealed:

1. None.
2. PVC, Color-Coded by System: 30 mils thick.
3. Aluminum, Corrugated: 0.016 inch thick.
4. Painted Aluminum, Smooth: 0.016 inch thick.
5. Stainless Steel, Type 304 or Type 316, Smooth No. 2B Finish: 0.010 inch thick.

D. Piping, Exposed:

1. None.
2. PVC, Color-Coded by System: 30 mils thick.
3. Aluminum, Corrugated: 0.016 inch thick.
4. Painted Aluminum, Smooth: 0.016 inch thick.
5. Stainless Steel, Type 304 or Type 316, Smooth No. 2B Finish: 0.010 inch thick.

3.19 OUTDOOR, FIELD-APPLIED JACKET SCHEDULE

A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.

B. If more than one material is listed, selection from materials listed is Contractor's option.

C. Piping, Concealed:

1. None.
2. PVC, Color-Coded by System: 30 mils thick.
3. Aluminum, Corrugated: 0.016 inch thick.
4. Painted Aluminum, Smooth: 0.016 inch thick.
5. Stainless Steel, Type 304 or Type 316, Smooth No. 2B Finish: 0.010 inch thick.

D. Piping, Exposed:

1. PVC: 30 mils thick.
2. Painted Aluminum, Smooth: 0.016 inch thick.
3. Stainless Steel, Type 304, Smooth No. 2B Finish: 0.010 inch thick.

3.20 UNDERGROUND, FIELD-APPLIED INSULATION JACKET

A. For underground direct-buried piping applications, install underground direct-buried jacket over insulation material.

END OF SECTION 22 07 19

SECTION 221116 - DOMESTIC WATER PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Copper tube, drawn temper - domestic water.
2. Copper tube, annealed temper - domestic water.
3. Copper tube fittings, solder joint - domestic water.
4. Wrought-copper, solder-joint fittings - domestic water.
5. Copper tube fittings, mechanically formed tee - domestic water.
6. Copper tube appurtenances, grooved end, mechanical joint - domestic water.
7. Copper or bronze, pressure-seal-joint fittings - domestic water.
8. PEX A tube and fittings - domestic water.
9. Pipe joining materials - domestic water.
10. Encasement for piping.
11. Transition fittings - domestic water.
12. Dielectric fittings - domestic water.

B. Related Requirements:

1. Section 331415 "Site Water Distribution Piping" for water-service piping and water meters outside the building from source to the point where water-service piping enters the building.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of specified product.

1.3 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Piping layout, or BIM model, drawn to scale, showing the items described in this Section, and coordinated with all building trades.

B. System purging and disinfecting activities report.

C. Field Quality -Control Reports: For specified tests and inspections.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: Installers of pressure-sealed joints are to be certified by pressure-seal joint manufacturer as having been trained and qualified to join piping with pressure-seal pipe couplings and fittings.

1.5 FIELD CONDITIONS

A. Interruption of Existing Water Service: Do not interrupt water service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary water service in accordance with requirements indicated:

1. Notify Architect no fewer than two days in advance of proposed interruption of water service.
2. Do not interrupt water service without Architect's written permission.

1.6 WARRANTY

A. Polypropylene (PP-R and PP-RCT) Pipe and Fittings Manufacturer's Warranty: Manufacturer agrees to repair or replace PP-R and PP-RCT pipe and fittings that fail in materials or workmanship within 10 years from date of Substantial Completion.

1. Warranty is to cover labor and material costs of repairing and/or replacing defective materials and repairing any incidental damage caused by failure of piping system due to defects in materials or manufacturing.
2. Warranty is to be in effect only upon submission by Contractor to manufacturer of valid pressure/leak documentation indicating that the system was tested and passed manufacturer's pressure/leak test.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Domestic water piping, tubing, fittings, joints, and appurtenances intended to convey or dispense water for human consumption are to comply with the U.S. Safe Drinking Water Act, with requirements of authorities having jurisdiction, and with NSF/ANSI/CAN 61 and NSF/ANSI/CAN 372, or be certified in compliance with NSF/ANSI/CAN 61 and NSF/ANSI/CAN 372 by an ANSI-accredited third-party certification body, in that the weighted average lead content at wetted surfaces is less than or equal to 0.25 percent.

2.2 PIPING MATERIALS

A. Potable-water piping and components are to comply with NSF/ANSI 14, NSF/ANSI/CAN 61, and NSF/ANSI/CAN 372. Include marking "NSF-pw" on piping.

2.3 COPPER TUBE AND FITTINGS - DOMESTIC WATER

A. Copper Tube, Drawn Temper - Domestic Water:

B. Copper Tube, Annealed Temper - Domestic Water:

C. Copper Tube Fittings, Solder Joint - Domestic Water:

D. Wrought-Copper, Solder-Joint Fittings - Domestic Water: ASME B16.22, pressure fittings. Do not use solder joints on pipe sizes greater than **NPS 4**.

E. Copper Tube Fittings, Mechanically Formed Tee - Domestic Water: For forming T-branch on copper water tube.

F. Copper Tube Appurtenances, Grooved End, Mechanical Joint - Domestic Water:

G. Copper or Bronze, Pressure-Seal-Joint Fittings - Domestic Water:

2.4 PEX TUBE AND FITTINGS - DOMESTIC WATER

A. PEX A Tube & Fittings - Domestic Water: Only copper ends shall be used. No plastic pipes shall be exposed outside a wall whether under a counter top or not.

1. Manufacturers:

a. NIBCO, Inc.
b. Oatey Co.
c. SharkBite, A Division of Reliance Worldwide Corporation
d. Uponor, Inc.

2.5 PIPE JOINING MATERIALS - DOMESTIC WATER

A. Pipe-Flange Gasket Materials:

1. AWWA C110/A21.10, rubber, flat face, **1/8 inch** thick or ASME B16.21, nonmetallic and asbestos free.
2. Full-face or ring type.

B. Metal Pipe-Flange Bolts and Nuts: ASME B18.2.1, carbon steel.

C. Solder Filler Metals: ASTM B32, lead-free alloys.

D. Flux: ASTM B813, water flushable.

E. Brazing Filler Metals: AWS A5.8M/A5.8, BCuP Series, copper-phosphorus alloys for general-duty brazing.

2.6 TRANSITION FITTINGS - DOMESTIC WATER

A. Sleeve-Type Transition Couplings - Domestic Water: AWWA C219.

PART 3 - EXECUTION

3.1 DOMESTIC WATER PIPING APPLICATIONS

A. Transition and special fittings with pressure ratings at least equal to piping rating may be used in applications in paragraphs below.

B. Flanges and unions may be used for aboveground piping joints.

C. Fitting Option: Extruded-tee connections and brazed joints may be used on aboveground copper tubing.

D. Under-Building-Slab, Domestic Water, Building-Service Piping, NPS 3 (DN 80) and Smaller: To be the following:

1. Annealed-Temper Copper Tube: ASTM B88, Type K; wrought-copper, solder-joint fittings; and brazed joints.

E. Under-Building-Slab, Domestic Water, Building-Service Piping, NPS 4 to NPS 8 (DN 100 to DN 200) and Larger: To be the following:

1. Annealed-Temper Copper Tube: ASTM B88, Type K; wrought-copper, solder-joint fittings; and brazed joints.

F. Under-Building-Slab, Combined Domestic Water, Building-Service, and Fire-Service-Main Piping, NPS 6 to NPS 12 (DN 150 to DN 300): To be the following:

G. Under-Building-Slab, Domestic Water Piping, NPS 2 (DN 50) and Smaller: To be the following:

1. Drawn-Temper Copper Tube: **ASTM B88, Type L**; wrought-copper, solder-joint fittings; and brazed joints.
2. Annealed-Temper Copper Tube: **ASTM B88, Type L**; wrought-copper, solder-joint fittings; and brazed joints.

H. Aboveground Domestic Water Piping, NPS 2 (DN 50) and Smaller: To be the following:

1. Drawn-Temper Copper Tube: ASTM B88, Type L.

a. Cast-copper or wrought-copper solder-joint fittings and brazed joints.
b. Copper pressure-seal-joint fittings and pressure-sealed joints.
c. Copper push-on-joint fittings; and push-on joints.

2. PEX A Tube - Domestic Water: **NPS 3** and smaller.

a. Fittings for PEX A tube:

1) ASTM F1807, metal insert and copper crimp rings.
2) ASTM F1960, cold expansion fittings and reinforcing rings.
3) ASSE/ANSI 1061, push-fit fittings.

I. Aboveground Domestic Water Piping, NPS 2-1/2 to NPS 4 (DN 65 to DN 100): To be the following:

1. Drawn-Temper Copper Tube: ASTM B88, Type L.

a. Cast-copper or wrought-copper solder-joint fittings and brazed joints.
b. Copper pressure-seal-joint fittings and pressure-sealed joints.
c. Grooved-end, copper-tube appurtenances; and grooved joints.

J. Aboveground Domestic Water Piping, NPS 5 to NPS 8 (DN 125 to DN 200): To be the following:

1. Drawn-Temper Copper Tube: ASTM B88, Type L.

a. Cast-copper or wrought-copper solder-joint fittings and brazed joints.
b. Grooved-end, copper-tube appurtenances; and grooved joints.

3.2 INSTALLATION OF DOMESTIC WATER PIPING, GENERAL

A. Requirements in this article apply to all piping materials, except where more specific requirements are specified in various pipe and fittings installation articles.

B. Drawing plans, schematics, and diagrams indicate general location and arrangement of domestic water piping. Indicated locations and arrangements are used to size pipe and calculate friction loss, expansion, and other design considerations. Install piping as indicated unless deviations to layout are approved on coordination drawings.

C. Install valves in accordance with Section 220523 "General-Duty Valves for Plumbing Piping."

D. Install water-pressure-reducing valves downstream from shutoff valves. Comply with requirements for pressure-reducing valves in Section 221119 "Domestic Water Piping Specialties."

E. Install domestic water piping level with 0.25 percent slope downward toward drain and plumb.

F. Rough-in domestic water piping for water-meter installation in accordance with utility company's requirements.

G. Install seismic restraints on piping. Comply with requirements for seismic-restraint devices in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment."

H. Install piping concealed from view and protected from physical contact by building occupants unless otherwise indicated and except in equipment rooms and service areas.

I. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

J. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal, and coordinate with other services occupying that space.

K. Install piping to permit valve servicing.

L. Install nipples, unions, special fittings, and valves with pressure ratings the same as or higher than the system pressure rating used in applications below.

M. Install piping free of sags and bends.

N. Install fittings for changes in direction and branch connections.

O. Install pressure gauges on suction and discharge piping for each plumbing pump and packaged booster pump. Comply with requirements for pressure gauges in Section 220500 "Common Work Results for Plumbing."

P. Install thermostats in hot-water circulation piping. Comply with requirements for thermostats in Section 221123.21 "Inline, Domestic-Water Pumps."

Q. Install thermometers on inlet and outlet piping from each water heater. Comply with requirements for thermometers in Section 220500 "Common Work Results for Plumbing."

R. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 220500 "Common Work Results for Plumbing."

S. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 220500 "Common Work Results for Plumbing."

T. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 220500 "Common Work Results for Plumbing."

U. Joint Construction, General:

1. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
2. Remove scale, slag, dirt, and debris from inside and outside of pipes, tubes, and fittings before assembly.
3. Threaded Joints: Thread pipe with tapered pipe threads in accordance with ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:

    a. Apply appropriate tape or thread compound to external pipe threads.
    b. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.

4. Joints for Dissimilar-Material Piping: Make joints using adapters compatible with materials of both piping systems.

3.3 INSTALLATION OF COPPER TUBE AND FITTINGS - DOMESTIC WATER

A. Install copper tubing under building slab in accordance with CDA's "Copper Tube Handbook."

B. Install underground copper tube in polyethylene encasement in accordance with ASTM A674 or AWWA C105/A21.5.

C. Install unions in copper tubing at final connection to each piece of equipment, machine, and specialty.

D. Joint Construction:

1. Brazed Joints for Copper Tubing: Comply with CDA's "Copper Tube Handbook," "Brazed Joints" chapter.
2. Soldered Joints for Copper Tubing: Apply ASTM B813, water-flushable flux to end of tube. Join copper tube and fittings in accordance with ASTM B828 or CDA's "Copper Tube Handbook."
3. Pressure-Sealed Joints for Copper Tubing: Join copper tube and pressure-seal fittings with tools and procedure recommended in writing by pressure-seal-fitting manufacturer. Leave insertion marks on pipe after assembly.
4. Push-on Joints for Copper Tubing: Clean end of tube. Measure insertion depth with manufacturer's depth gauge. Join copper tube and push-on-joint fittings by inserting tube to measured depth.
5. Extruded-Tee Connections: Form tee in copper tube in accordance with ASTM F2014. Use tool designed for copper tube; drill pilot hole, form collar for outlet, dimple tube to form seating stop, and braze branch tube into collar.
6. Grooved-End Copper Tubing: Make joints in accordance with AWWA C606. Roll groove ends of tubes. Lubricate and install gasket over ends of tubes or tube and fitting. Install coupling housing sections over gasket with keys seated in tubing grooves. Install and tighten housing bolts.

3.4 INSTALLATION OF PEX TUBE AND FITTINGS - DOMESTIC WATER

A. Install PEX tube with loop at each change of direction of more than 90 degrees.

B. Joint Construction:

1. Joints for PEX Tubing, ASTM: Join in accordance with ASTM F1807 for metal insert and copper crimp ring fittings and ASTM F1960 for cold expansion fittings and reinforcing rings.
2. Joints for PEX Tubing, ASSE: Join in accordance with ASSE/ANSI 1061 for push-fit fittings.

3.5 INSTALLATION OF PEX-AL-PEX TUBE AND FITTINGS - DOMESTIC WATER

A. Install PEX-AL-PEX tubing and fittings per manufacturer instructions.

B. Joint Connection:

1. Joints PEX-AL-PEX Tubing, ASTM: Join in accordance with using approved mechanical compression, press, or crimp fittings per ASTM F1281.

3.6 INSTALLATION OF POLYPROPYLENE PIPING AND FITTINGS - DOMESTIC WATER

A. Install Polypropylene piping and fitting per manufacturer's instructions.

B. Joint Connections:

1. Jointing Polypropylene Piping and Fittings, ASTM and ISO: Join by the use of the thermal fusion method specifically approved by the manufacturer based on ASTM F2389 and ISO 15874.

3.7 INSTALLATION OF TRANSITION FITTINGS - DOMESTIC WATER

A. Install transition couplings at joints of dissimilar piping.

B. Transition Fittings in Underground Domestic Water Piping:

1. Fittings for NPS 1-1/2 (DN 40) and Smaller: Fitting-type coupling.
2. Fittings for NPS 2 (DN 50) and Larger: Sleeve-type coupling.

C. Transition Fittings in Aboveground Domestic Water Piping NPS 2 (DN 50) and Smaller: Plastic-to-metal transition fittings or unions.

3.8 INSTALLATION OF DIELECTRIC FITTINGS - DOMESTIC WATER

A. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.

B. Dielectric Fittings for NPS 2 (DN 50) and Smaller: Use dielectric couplings or nipples.

C. Dielectric Fittings for NPS 2-1/2 to NPS 4 (DN 65 to DN 100): Use dielectric flange kits.

D. Dielectric Fittings for NPS 5 (DN 125) and Larger: Use dielectric flange kits.

3.9 INSTALLATION OF HANGERS AND SUPPORTS

A. Comply with requirements for seismic-restraint devices specified in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment."

B. Comply with requirements for hangers, supports, and anchor devices in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment."

C. Metal Tube/Pipe:

1. Install hangers with maximum horizontal spacing and minimum rod diameters, to comply with MSS SP-58, locally enforced codes, and authorities having

jurisdiction requirements, whichever are most stringent.

2. Support vertical runs of metal tube/pipe to comply with MSS SP-58, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.

D. Plastic Pipe:

1. Install vinyl-coated hangers with maximum horizontal spacing and minimum rod diameters, to comply with manufacturer's written instructions, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.
2. Support vertical runs of plastic pipe to comply with manufacturer's written instructions, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.

E. PEX Tube:

1. Install vinyl-coated hangers for PEX tube, with maximum horizontal spacing and minimum rod diameters, to comply with manufacturer's written instructions, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.
2. Support vertical runs of PEX tube to comply with manufacturer's written instructions, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.

F. Support horizontal piping within 12 inches of each fitting.

3.10 FIELD QUALITY CONTROL

A. Tests and Inspections:

1. Piping Inspections:

a. Do not enclose, cover, or put piping into operation until it has been inspected and approved by authorities having jurisdiction.
b. During installation, notify authorities having jurisdiction at least one day before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction:

1) Roughing-in Inspection: Arrange for inspection of piping before concealing or closing in after installation and before setting fixtures.
2) Final Inspection: Arrange for authorities having jurisdiction to observe tests specified in "Piping Tests" Subparagraph below and to ensure compliance with requirements.

c. Reinspection: If authorities having jurisdiction find that piping will not pass tests or inspections, make required corrections and arrange for reinspection.
d. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.

2. Piping Tests:

    a. Fill domestic water piping. Check components to determine that they are not air bound and that piping is full of water.
    b. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit a separate report for each test, complete with diagram of portion of piping tested.
    c. Leave new, altered, extended, or replaced domestic water piping uncovered and unconcealed until it has been tested and approved. Expose work that was covered or concealed before it was tested.
    d. Cap and subject piping to static water pressure of **50 psig** above operating pressure, without exceeding pressure rating of piping system materials. Isolate test source and allow it to stand for four hours. Leaks and loss in test pressure constitute defects that must be repaired.
    e. Polypropylene (PP-R and PP-RCT) Pipe: Hydrostatic testing and documentation of test results for polypropylene (PP-R and PP-RCT) pipe to be in accordance with manufacturer's written instructions and submitted to manufacturer upon successful completion per warranty requirements.
    f. Repair leaks and defects with new materials, and retest piping or portion thereof until satisfactory results are obtained.
    g. Prepare reports for tests and for corrective action required.

B. Domestic water piping will be considered defective if it does not pass tests and inspections.

C. Prepare test and inspection reports.

END OF SECTION 221116

SECTION 22 11 19 - DOMESTIC WATER PIPING SPECIALTIES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Vacuum breakers.
2. Backflow preventers.
3. Balancing valves.
4. Temperature-actuated, water mixing valves.
5. Strainers for domestic water piping.
6. Wall hydrants.
7. Drain valves.
8. Trap-seal primer device.
9. Trap-seal primer systems.
10. Flexible connectors.

B. Related Requirements:

1. Section 220500 "Common Work Results for Plumbing."
2. Section 221116 "Domestic Water Piping" for water meters.
3. Section 223200 "Domestic Water Filtration Equipment" for water filters in domestic water piping.
4. Section 224300 "Healthcare Plumbing Fixtures" for thermostatic mixing valves for sitz baths, thermostatic mixing-valve assemblies for hydrotherapy equipment, and outlet boxes for dialysis equipment.
5. Section 224500 "Emergency Plumbing Fixtures" for water tempering equipment.
6. Section 224700 "Drinking Fountains and Water Coolers."
7. Section 230923.18 "Leak Detection Instruments" for leak detection devices related to HVAC applications.
8. Section 331415 "Site Water Distribution Piping" for fire water-service backflow prevention devices.

1.2 DEFINITIONS

A. AMI: Advanced Metering Infrastructure.

B. AMR: Automatic Meter Reading.

C. FKM: A family of fluoroelastomer materials defined by ASTM D1418.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For domestic water piping specialties.

1. Include diagrams for power, signal, and control wiring.

1.4 INFORMATIONAL SUBMITTALS

A. Test and inspection reports.

B. Field quality-control reports.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For domestic water piping specialties to include in emergency, operation, and maintenance manuals.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR PIPING SPECIALTIES

A. Domestic water piping specialties intended to convey or dispense water for human consumption are to comply with the SDWA, requirements of authorities having jurisdiction, and NSF 61 and NSF 372, or to be certified in compliance with NSF 61 and NSF 372 by an American National Standards Institute (ANSI)-accredited third-party certification body that the weighted average lead content at wetted surfaces is less than or equal to 0.25 percent.

2.2 PERFORMANCE REQUIREMENTS

A. Minimum Working Pressure for Domestic Water Piping Specialties: 125 psig unless otherwise indicated.

2.3 VACUUM BREAKERS

A. Pipe-Applied, Atmospheric-Type Vacuum Breakers:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Apollo Valves; a part of Aalberts Integrated Piping Systems
b. Cash Acme Plumbing Products; an RWC brand
c. FEBCO; A WATTS Brand
d. WATTS; A Watts Water Technologies Company
e. Zurn Industries, LLC

2. Standard: ASSE 1001.

3. Size: NPS 1/4 to NPS 3, as required to match connected piping.
4. Body: Bronze.
5. Inlet and Outlet Connections: Threaded.
6. Finish: Rough bronze.

B. Hose-Connection Vacuum Breakers:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

    a. Apollo Valves; a part of Aalberts Integrated Piping Systems
    b. Cash Acme Plumbing Products; an RWC brand
    c. Champion-Arrowhead
    d. MIFAB, Inc
    e. WATTS; A Watts Water Technologies Company
    f. Woodford Manufacturing Company
    g. Zurn Industries, LLC

2. Standard: ASSE 1011.
3. Body: Bronze, nonremovable, with manual drain.
4. Outlet Connection: Garden-hose threaded complying with ASME B1.20.7.
5. Finish: Chrome or nickel plated.

C. Pressure Vacuum Breakers:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

    a. Apollo Valves; a part of Aalberts Integrated Piping Systems
    b. FEBCO; A WATTS Brand
    c. WATTS; A Watts Water Technologies Company
    d. Zurn Industries, LLC

2. Standard: ASSE 1020.
3. Operation: Continuous-pressure applications.
4. Pressure Loss: 5 psig maximum, through middle third of flow range.
5. Accessories:

    a. Valves: Ball type, on inlet and outlet.

2.4 BACKFLOW PREVENTERS

A. Double-Check, Backflow-Prevention Assemblies:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Ames Fire & Waterworks; A Watts Water Technologies Company
b. Apollo Valves; a part of Aalberts Integrated Piping Systems
c. FEBCO; A WATTS Brand
d. WATTS; A Watts Water Technologies Company
e. Zurn Industries, LLC

2. Basis-of-Design Product: Subject to compliance with requirements, provide backflow preventer or comparable product by one of the following:

a. Ames Fire & Waterworks; A Watts Water Technologies Company
b. Apollo Valves; a part of Aalberts Integrated Piping Systems
c. FEBCO; A WATTS Brand
d. WATTS; A Watts Water Technologies Company
e. Zurn Industries, LLC

3. Standard: ASSE 1015.
4. Operation: Continuous-pressure applications unless otherwise indicated.
5. Pressure Loss: 5 psig maximum, through middle third of flow range.
6. Size: on.
7. Body: Bronze or stainless steel for NPS 2 and smaller; ductile or cast iron with interior lining that complies with AWWA C550 or that is FDA approved or stainless steel for NPS 2-1/2 and larger.
8. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and larger.
9. Configuration: Designed for horizontal, straight-through flow.
10. Accessories:

a. Valves NPS 2 (DN 50) and Smaller: Ball type with threaded ends on inlet and outlet.
b. Valves NPS 2-1/2 (DN 65) and Larger: Outside-screw and yoke-gate type with flanged ends on inlet and outlet.

B. Beverage-Dispensing-Equipment Backflow Preventers:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Apollo Valves; a part of Aalberts Integrated Piping Systems
b. WATTS; A Watts Water Technologies Company
c. Zurn Industries, LLC

2. Standard: ASSE 1022.
3. Operation: Continuous-pressure applications.
4. Size: NPS 1/4 or NPS 3/8.
5. Body: Stainless steel or non-metallic.
6. End Connections: Threaded or flare.

C. Carbonated-Beverage-Dispenser, Dual-Check-Valve Backflow Preventers:

1. Manufacturers: Subject to compliance with requirements, available

manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. WATTS; A Watts Water Technologies Company

2. Basis-of-Design Product: Subject to compliance with requirements, provide hose connection backflow or comparable product by one of the following:

a. WATTS; A Watts Water Technologies Company

3. Standard: ASSE 1032.
4. Operation: Continuous-pressure applications.
5. Size: NPS 1/4 or NPS 3/8.
6. Body: Stainless steel.
7. End Connections: Threaded or flare.

D. Hose-Connection Backflow Preventers:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Apollo Valves; a part of Aalberts Integrated Piping Systems
b. WATTS; A Watts Water Technologies Company
c. Woodford Manufacturing Company
d. Zurn Industries, LLC

2. Standard: ASSE 1052.
3. Operation: Up to 10-ft. head of water back pressure.
4. Inlet Size: NPS 3/4.
5. Outlet Size: Garden-hose thread complying with ASME B1.20.7.
6. Capacity: At least 3-gpm flow.

2.5 BALANCING VALVES

A. Copper-Alloy Calibrated Balancing Valves:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Bell & Gossett; a Xylem brand
b. Nexus Valve, Inc.; Aalberts Hydronic Flow Control
c. NIBCO INC.
d. WATTS; A Watts Water Technologies Company

2. Basis-of-Design Product: Subject to compliance with requirements, provide balancing valve or comparable product by one of the following:

a. Bell & Gossett; a Xylem brand

b. Nexus Valve, Inc.; Aalberts Hydronic Flow Control
c. NIBCO INC.
d. WATTS; A Watts Water Technologies Company

3. Type: Ball or Y-pattern globe valve with two readout ports and memory-setting indicator.
4. Body: bronze.
5. Size: Same as connected piping, but not larger than NPS 2.
6. Accessories: Meter hoses, fittings, valves, differential pressure meter, and carrying case.

B. Memory-Stop Balancing Valves:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Apollo Valves; a part of Aalberts Integrated Piping Systems
b. Caleffi North America
c. Crane Fluid Systems; Crane Co.
d. Hammond Valve
e. Jenkins Valves; a Crane Co. brand
f. Milwaukee Valve Company
g. NIBCO INC.
h. Red-White Valve Corp.
i. Stockham; a Crane Co. brand

2. Standard: MSS SP-110 for two-piece, copper-alloy ball valves.
3. Pressure Rating: 400-psig minimum CWP.
4. Size: NPS 2 or smaller.
5. Body: Copper alloy.
6. Port: Standard or full port.
7. Ball: Chrome-plated brass or stainless steel.
8. Seats and Seals: Replaceable.
9. End Connections: Solder joint or threaded.
10. Handle: Vinyl-covered steel with memory-setting device.

2.6 TEMPERATURE-ACTUATED, WATER MIXING VALVES

A. Primary, Thermostatic, Water Mixing Valves:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Acorn Engineering Company; a Division of Morris Group International
b. Apollo Valves; a part of Aalberts Integrated Piping Systems
c. Caleffi North America
d. Cash Acme Plumbing Products; an RWC brand
e. Lawler Manufacturing Company, Inc

f. POWERS; A Watts Water Technologies Company
g. Symmons Industries, Inc
h. WATTS; A Watts Water Technologies Company
i. Zurn Industries, LLC

2. Standard: ASSE 1017.
3. Pressure Rating: 125 psig minimum unless otherwise indicated.
4. Type: Exposed-mounted, thermostatically controlled, water mixing valve.
5. Material: Bronze body with corrosion-resistant interior components.
6. Connections: Threaded union inlets and outlet.
7. Accessories: Manual temperature control, check stops on hot- and cold-water supplies, and adjustable, temperature-control handle.
8. Tempered-Water Setting: 110 deg F.
9. Tempered-Water Design Flow Rate: as scheduled.
10. Pressure Drop at Design Flow Rate: 5 psig.
11. Valve Finish: Chrome plated.
12. Piping Finish: Chrome plated.

2.7 STRAINERS FOR DOMESTIC WATER PIPING

A. Y-Pattern Strainers:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Caleffi North America
b. Keckley Company
c. Titan Flow Control, Inc.
d. WATTS; A Watts Water Technologies Company
e. Zurn Industries, LLC

2. Pressure Rating: 125 psig minimum unless otherwise indicated.
3. Body: Bronze for NPS 2 and smaller; cast iron with interior lining that complies with AWWA C550 or that is FDA approved, epoxy coated and for NPS 2-1/2 and larger.
4. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and larger.
5. Screen: Stainless steel with round perforations unless otherwise indicated.
6. Perforation Size:

a. Strainers NPS 2 (DN 50) and Smaller: 0.020 inch.
b. Strainers NPS 2-1/2 to NPS 4 (DN 65 to DN 100): 0.045 inch.
c. Strainers NPS 5 (DN 125) and Larger: 0.10 inch.

7. Drain: Pipe plug.

2.8 WALL HYDRANTS

A. Nonfreeze, Hot- and Cold-Water Wall Hydrants:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

    a. Jay R. Smith Mfg Co; a division of Morris Group International
    b. Josam Company
    c. MIFAB, Inc
    d. Murdock Manufacturing; A Division of Morris Group International
    e. Prier Products, Inc.
    f. WATTS; A Watts Water Technologies Company
    g. Woodford Manufacturing Company
    h. Zurn Industries, LLC

2. Standard: ASME A112.21.3M for concealed -outlet, self-draining wall hydrants.
3. Pressure Rating: 125 psig.
4. Operation: Loose key.
5. Casing and Operating Rods: Of length required to match wall thickness. Include wall clamps.
6. Inlet: NPS 3/4 or NPS 1.
7. Outlet: Concealed.
8. Box: Deep, flush mounted with cover.
9. Box and Cover Finish: Polished nickel bronze.
10. Vacuum Breaker:

    a. Nonremovable, manual-drain-type, hose-connection vacuum breaker complying with ASSE 1011 or backflow preventer complying with ASSE 1052.
    b. Garden-hose thread complying with ASME B1.20.7 on outlet.

11. Operating Key(s): Two with each wall hydrant.

2.9 DRAIN VALVES

A. Ball-Valve-Type, Hose-End Drain Valves:

1. Standard: MSS SP-110 for standard-port, two-piece ball valves.
2. Pressure Rating: 400-psig minimum CWP.
3. Size: NPS 3/4.
4. Body: Copper alloy.
5. Ball: Chrome-plated brass.
6. Seats and Seals: Replaceable.
7. Handle: Vinyl-covered steel.
8. Inlet: Threaded or solder joint.
9. Outlet: Threaded, short nipple with garden-hose thread complying with ASME B1.20.7 and cap with brass chain.

B. Gate-Valve-Type, Hose-End Drain Valves:

1. Standard: MSS SP-80 for gate valves.
2. Pressure Rating: Class 125.
3. Size: NPS 3/4.
4. Body: ASTM B62 bronze.
5. Inlet: NPS 3/4 threaded or solder joint.
6. Outlet: Garden-hose thread complying with ASME B1.20.7 and cap with brass chain.

C. Stop-and-Waste Drain Valves:

1. Standard: MSS SP-110 for ball valves or MSS SP-80 for gate valves.
2. Pressure Rating: 200-psig minimum CWP or Class 125.
3. Size: NPS 3/4.
4. Body: Copper alloy or ASTM B62 bronze.
5. Drain: NPS 1/8 side outlet with cap.

2.10 TRAP-SEAL PRIMER DEVICE

A. Supply-Type, Trap-Seal Primer Device:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

   a. Jay R. Smith Mfg Co; a division of Morris Group International
   b. Josam Company
   c. MIFAB, Inc
   d. Precision Plumbing Products
   e. ProFlo; a Ferguson Enterprises, Inc. brand
   f. Sioux Chief Manufacturing Company, Inc.
   g. WATTS; A Watts Water Technologies Company
   h. Zurn Industries, LLC

2. Standard: ASSE 1018.
3. Pressure Rating: 125 psig minimum.
4. Body: Bronze.
5. Inlet and Outlet Connections: NPS 1/2 threaded, union, or solder joint.
6. Gravity Drain Outlet Connection: NPS 1/2 threaded or solder joint.
7. Finish: Chrome plated, or rough bronze for units used with pipe or tube that is not chrome finished.

2.11 TRAP-SEAL PRIMER SYSTEMS

A. Trap-Seal Primer Systems:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include,

but are not limited to, the following:

a. Precision Plumbing Products
b. Sioux Chief Manufacturing Company, Inc.
c. Zurn Industries, LLC

2. Standard: ASSE 1044.
3. Inlet Size: NPS 3/4, ASTM B88, Type L; copper, water tubing.
4. Cabinet: Recessed -mounted steel box with stainless steel cover.
5. Electric Controls: 24-hour timer, solenoid valve, and manual switch for 120 V ac power.

a. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

6. Vacuum Breaker: ASSE 1001.
7. Number Outlets: Four.
8. Size Outlets: NPS 1/2.

2.12 FLEXIBLE CONNECTORS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Flex-Hose Co., Inc
2. Mason Industries, Inc.
3. Metraflex Company (The)

B. Bronze-Hose Flexible Connectors: Corrugated-bronze tubing with bronze wire-braid covering and ends brazed to inner tubing.

1. Working-Pressure Rating: Minimum 200 psig.
2. End Connections NPS 2 (DN 50) and Smaller: Threaded copper pipe or plain-end copper tube.
3. End Connections NPS 2-1/2 (DN 65) and Larger: Flanged copper alloy.

C. Stainless Steel-Hose Flexible Connectors: Corrugated-stainless steel tubing with stainless steel wire-braid covering and ends welded to inner tubing.

1. Working-Pressure Rating: Minimum 200 psig.
2. End Connections NPS 2 (DN 50) and Smaller: Threaded steel-pipe nipple.
3. End Connections NPS 2-1/2 (DN 65) and Larger: Flanged steel nipple.

PART 3 - EXECUTION

3.1 INSTALLATION OF PIPING SPECIALTIES

A. Backflow Preventers: Install in each water supply to mechanical equipment and systems and to other equipment and water systems that may be sources of contamination. Comply with authorities having jurisdiction.

1. Locate backflow preventers in same room as connected equipment or system.
2. Install drain for backflow preventers with atmospheric-vent drain connection with air-gap fitting, fixed air-gap fitting, or equivalent positive pipe separation of at least two pipe diameters in drain piping and pipe-to-floor drain. Locate air-gap device attached to or under backflow preventer. Simple air breaks are unacceptable for this application.
3. Do not install bypass piping around backflow preventers.

B. Water Regulators: Install with inlet and outlet shutoff valves and bypass with memory-stop balancing valve. Install pressure gauges on inlet and outlet.

C. Water Control Valves: Install with inlet and outlet shutoff valves and bypass with globe valve. Install pressure gauges on inlet and outlet.

D. Automatic Water Shutoff Valves: Test for signal strength before valve installation. Install automatic shutoff valve downstream from main domestic water shutoff valve. Install valve controller in an accessible location with sensors in areas where water is likely to accumulate.

E. Balancing Valves: Install in locations where they can easily be adjusted. Set at indicated design flow rates.

F. Temperature-Actuated, Water Mixing Valves: Install with check stops or shutoff valves on inlets and with shutoff valve on outlet.

1. Install cabinet-type units recessed in or surface mounted on wall as specified.

G. Y-Pattern Strainers: For water, install on supply side of each control valve solenoid valve and pump.

H. Outlet Boxes: Install boxes recessed in wall or surface mounted on wall. Install 1-1/2-by-3-1/2-inch fire-retardant-treated-wood blocking, wall reinforcement between studs. Comply with requirements for fire-retardant-treated-wood blocking in Section 061000 "Rough Carpentry."

I. Hose Stations: Install with check stops or shutoff valves on inlets and with thermometer on outlet.

1. Install cabinet-type units recessed in or surface mounted on wall as specified. Install 1-1/2-by-3-1/2-inch fire-retardant-treated-wood blocking, wall reinforcement between studs. Comply with requirements for fire-retardant-treated-wood blocking in Section 061000 "Rough Carpentry."

J. Ground Hydrants: Install with 1 cu. yd. of crushed gravel around drain hole. Set ground hydrants with box flush with grade.

K. Nonfreeze, Draining-Type Post Hydrants: Install with 1 cu. yd. of crushed gravel around drain hole. Set post hydrants in concrete paving or in 1 cu. ft. of concrete block at grade.

L. Nonfreeze, Nondraining-Type Post Hydrants: Set in concrete or pavement.

M. Nonfreeze, Sanitary Yard Hydrants: Set with riser pipe in concrete or pavement. Do not encase canister in concrete.

N. Nonfreeze, Draining-Type Roof Hydrants: Install with drain connection piped to nearest floor drain or to the exterior.

O. Water-Hammer Arresters: Install in water piping in accordance with PDI-WH 201.

P. Supply-Type, Trap-Seal Primer Device: Install with outlet piping pitched down toward drain trap a minimum of 1 percent, and connect to floor-drain body, trap, or inlet fitting. Adjust valve for proper flow.

Q. Drainage-Type, Trap-Seal Primer Device: Install as lavatory trap with outlet piping pitched down toward drain trap a minimum of 1 percent, and connect to floor-drain body, trap, or inlet fitting.

R. Trap-Seal Primer Systems: Install with outlet piping pitched down toward drain trap a minimum of 1 percent, and connect to floor-drain body, trap, or inlet fitting. Adjust system for proper flow.

3.2 PIPING CONNECTIONS

A. Drawings indicate general arrangement of piping, fittings, and specialties.

B. When installing piping specialties adjacent to equipment and machines, allow space for service and maintenance.

3.3 ELECTRICAL CONNECTIONS

A. Connect wiring in accordance with Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

B. Ground equipment in accordance with Section 260526 "Grounding and Bonding for Electrical Systems."

C. Install electrical devices furnished by manufacturer, but not factory mounted, in accordance with NFPA 70 and NECA 1.

3.4 CONTROL CONNECTIONS

A. Connect control wiring in accordance with Section 260523 "Control-Voltage Electrical Power Cables."

3.5 IDENTIFICATION

A. Plastic Labels for Equipment: Install engraved plastic-laminate equipment nameplate or sign on or near each of the following:

1. Vacuum breakers.
2. Backflow preventers.
3. Water pressure-reducing valves.
4. Automatic water shutoff valve systems.
5. Balancing valves.
6. Temperature-actuated, water mixing valves.
7. Outlet boxes.
8. Hose stations.
9. Wall hydrants.
10. Ground hydrants.
11. Post hydrants.
12. Roof hydrants.
13. Trap-seal primer device.
14. Trap-seal primer systems.
15. Water meters.

B. Distinguish among multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations, in addition to identifying unit. Nameplates and signs are specified in Section 220553 "Identification for Plumbing Piping and Equipment."

3.6 ADJUSTING

A. Set field-adjustable pressure set points of water pressure-reducing valves.

B. Set field-adjustable flow set points of balancing valves.

C. Set field-adjustable temperature set points of temperature-actuated, water mixing valves.

D. Adjust each pressure vacuum breaker reduced-pressure-principle backflow preventer double-check, backflow-prevention assembly and double-check, detector-assembly backflow preventer in accordance with manufacturer's written instructions, authorities having jurisdiction and the device's reference standard.

3.7 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

C. Perform the following tests and inspections with the assistance of a factory-authorized service representative.

1. Test each reduced-pressure-principle backflow preventer anddouble-check, detector-assembly backflow preventer according to authorities having jurisdiction and the device's reference standard.
2. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
3. Operational Test: After electrical circuitry has been energized, start units to confirm unit operation.
4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

D. Domestic water piping specialties will be considered defective if they do not pass tests and inspections.

E. Prepare test and inspection reports.

END OF SECTION 22 11 19

SECTION 22 11 23.21 - INLINE, DOMESTIC-WATER PUMPS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Horizontally mounted, in-line, close-coupled centrifugal pumps.

B. Related Requirements:

1. Section 221123.13 "Domestic-Water Packaged Booster Pumps" for booster systems.
2. Section 331113 "Potable Water Supply Wells" for well pumps.

1.2 ACTION SUBMITTALS

A. Product Data Submittals: For each product. Include construction materials, rated capacities, certified performance curves with operating points plotted on curves, operating characteristics, electrical characteristics, and furnished specialties and accessories.

B. Sustainable Design Submittals:

1.3 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Detail pumps and adjacent equipment. Show support locations, type of support, weight on each support, required clearances, and other details, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:

1. Structural members to which pumps will be attached.
2. Size and location of initial access modules for acoustical tile.

B. Seismic Qualification Data: Certificates, for inline, domestic-water pumps, accessories, and components, from manufacturer.

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

C. Field quality-control reports.

1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For inline, domestic-water pumps to include in operation and maintenance manuals.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Retain shipping flange protective covers and protective coatings during storage.

B. Protect bearings and couplings against damage.

C. Comply with pump manufacturer's written instructions for handling.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. UL Compliance: UL 778 for motor-operated water pumps.

C. Drinking Water System Components - Health Effects and Drinking Water System Components - Lead Content Compliance: NSF 61 and NSF 372.

2.2 HORIZONTALLY MOUNTED, IN-LINE, CLOSE-COUPLED CENTRIFUGAL PUMPS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Bell & Gossett; a Xylem brand
2. Taco Comfort Solutions

B. Description: Factory-assembled and -tested, in-line, single-stage, close-coupled, overhung-impeller centrifugal pumps designed for installation with pump and motor shaft mounted horizontal.

C. Capacities and Characteristics:

1. Capacity: **on**.
2. Pump Control: Thermostat.
3. Electrical Characteristics:

a. Volts: 120 V.
b. Phases: Single phase.
c. Hertz: 60 Hz.

D. Pump Construction:

1. Casing:

a. Radially split bronze brass or stainless steel with threaded companion-flange connections for pumps with **NPS 2** pipe connections and flanged connections for pumps with **NPS 2-1/2** pipe connections.
b. Built to permit servicing of pump internals without disturbing the casing or the suction and discharge piping.
c. Gauge port tappings at suction and discharge nozzles.

2. Impeller: Bronzeorbrass, statically and dynamically balanced, closed, and keyed to shaft.
3. Shaft and Shaft Sleeve: Steel shaft with deflector, with copper-alloy shaft sleeve. Include water slinger on shaft between motor and seal.
4. Shaft Coupling: Flexible, capable of absorbing torsional vibration and shaft misalignment.
5. Seal: Mechanical, with carbon-steel rotating ring, stainless-steel spring, ceramic seat, and rubber bellows and gasket.
6. Bearings: permanently lubricated ball type.
7. Minimum Working Pressure: 175 psig.
8. Continuous Operating Temperature: 225 deg F.

E. Motor: Single speed, with grease-lubricated ball bearings; resiliently mounted to pump casing.

2.3 MOTORS

A. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Section 220500 "Common Work Results for Plumbing."

1. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.

2.4 CONTROLS

A. Pressure Switches: Electric, adjustable for control of water-supply pump.

1. Type: Water-immersion pressure sensor, for installation in piping.
2. Enclosure: NEMA 250, Type 4X.
3. Operation of Pump: On or off.
4. Transformer: Provide if required.
5. Power Requirement: 120 V ac.

B. Thermostats: Electric; adjustable for control of hot-water circulation pump.

1. Type: Water-immersion temperature sensor, for installation in piping.
2. Range: 100 to 240 deg F.

3. Enclosure: NEMA 250, Type 4X.
4. Operation of Pump: On or off.
5. Transformer: Provide if required.
6. Power Requirement: 120 V ac.
7. Settings: Start pump at 105 deg F and stop pump at 115 deg F.

C. Time-Delay Relays: Electric, for control of hot-water circulation pump between water heater and connected hot-water storage tank.

1. Type: Adjustable time-delay relay.
2. Range: Up to five minutes.
3. Setting: Five minutes.
4. Enclosure: NEMA 250, Type 4X.
5. Operation of Pump: On or off.
6. Transformer: Provide if required.
7. Power Requirement: 120 V ac.
8. Programmable Sequence of Operation: Limit pump operation to periods of burner operation, plus maximum five minutes after the burner stops.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine roughing-in for domestic-water-piping system to verify actual locations of piping connections before pump installation.

3.2 INSTALLATION OF PUMPS

A. Comply with HI 1.4.

B. Mount pumps in orientation complying with manufacturer's written instructions.

C. Pump Mounting:

1. Install vertically mounted, in-line, close-coupled centrifugal pumps with cast-iron base mounted on concrete base using vibration isolation type and deflection as specified in Section 220548.13 "Vibration Controls for Plumbing Piping and Equipment." Comply with requirements for concrete base specified in Section 033000 "Cast-in-Place Concrete."
2. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on **18-inch** centers around the full perimeter of concrete base.
3. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
4. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
5. Install anchor bolts to elevations required for proper attachment to supported equipment.

D. Install continuous-thread hanger rods and vibration isolation of size required to support pump weight.

1. Comply with requirements for vibration isolation devices specified in Section 220548.13 "Vibration Controls for Plumbing Piping and Equipment." Fabricate brackets or supports as required.
2. Comply with requirements for hangers and supports specified in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment."

E. Install pressure switches in water-supply piping.

F. Install thermostats in hot-water return piping.

G. Install timers in mechanical room.

H. Install time-delay relays in piping between water heaters and hot-water storage tanks.

3.3 PIPING CONNECTIONS

A. Comply with requirements for piping specified in Section 221116 "Domestic Water Piping." Drawings indicate general arrangement of piping, fittings, and specialties.

B. Where installing piping adjacent to inline, domestic-water pumps, allow space for service and maintenance.

C. Connect domestic-water piping to pumps. Install suction and discharge piping equal to or greater than size of pump nozzles.

1. Install flexible connectors adjacent to pumps in suction and discharge piping of the following pumps:

a. Horizontally mounted, in-line, separately coupled centrifugal pumps.
b. Horizontally mounted, in-line, close-coupled centrifugal pumps.
c. Vertically mounted, in-line, close-coupled centrifugal pumps.
d. Comply with requirements for flexible connectors specified in Section 221116 "Domestic Water Piping."

D. Install shutoff valve and strainer on suction side of each pump, and check, shutoff, and throttling valves on discharge side of each pump. Install valves same size as connected piping. Comply with requirements for strainers specified in Section 221119 "Domestic Water Piping Specialties." Comply with requirements for valves specified in Section 220523 "General-Duty Valves for Plumbing Piping."

1. Install pressure gauge and snubber at suction of each pump and pressure gauge and snubber at discharge of each pump. Install at integral pressure-gauge tappings where provided or install pressure-gauge connectors in suction and discharge piping around pumps. Comply with requirements for pressure gauges and snubbers specified in Section 220500 "Common Work Results for Plumbing."

3.4 CONTROL CONNECTIONS

A. Install control and electrical power wiring to field-mounted control devices.

B. Connect control wiring between temperature controllers and devices.

3.5 IDENTIFICATION

A. Identify system components. Comply with requirements for identification specified in Section 220553 "Identification for Plumbing Piping and Equipment" for identification of pumps.

3.6 FIELD QUALITY CONTROL

A. Testing Agency:

1. Owner will engage a qualified testing agency to perform tests and inspections.
2. Engage a qualified testing agency to perform tests and inspections.

B. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

C. Perform tests and inspections with the assistance of a factory-authorized service representative.

D. Tests and Inspections:

1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
2. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

E. Inline, domestic-water pump will be considered defective if it does not pass tests and inspections.

F. Prepare test and inspection reports.

3.7 STARTUP SERVICE

A. Perform startup service.

1. Complete installation and startup checks according to manufacturer's written instructions.
2. Check piping connections for tightness.
3. Clean strainers on suction piping.
4. Set thermostats, for automatic starting and stopping operation of pumps.

5. Perform the following startup checks for each pump before starting:

    a. Verify bearing lubrication.
    b. Verify that pump is free to rotate by hand and that pump for handling hot liquid is free to rotate with pump hot and cold. If pump is bound or drags, do not operate until cause of trouble is determined and corrected.
    c. Verify that pump is rotating in the correct direction.

6. Prime pump by opening suction valves and closing drains, and prepare pump for operation.
7. Start motor.
8. Open discharge valve slowly.
9. Adjust temperature settings on thermostats.
10. Adjust timer settings.

3.8 ADJUSTING

A. Adjust inline, domestic-water pumps to function smoothly, and lubricate as recommended by manufacturer.

B. Adjust initial temperature set points.

C. Set field-adjustable switches and circuit-breaker trip ranges as indicated.

END OF SECTION 22 11 23.21

SECTION 22 13 16 - SANITARY WASTE AND VENT PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. PVC sanitary waste and vent pipe and fittings.
2. Sanitary waste and vent specialty pipe fittings.
3. Encasement for underground metal piping.

B. Related Requirements:

1. Section 220719 "Plumbing Piping Insulation" for piping insulation.
2. Section 221329 "Sanitary Sewerage Pumps" for effluent and sewage pumps.

1.2 DEFINITIONS

A. Sanitary Waste and Vent Piping: Inclusive of sanitary soil, waste, and vent pipe and fittings.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For hubless, single-stack drainage system. Include plans, elevations, sections, and details.

C. Sustainable Design Submittals:

1.4 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Plans and elevations, or Building Information Model (BIM) drawn to scale, showing items described in this Section and coordinated with all building trades.

B. Seismic Qualification Certificates: For waste and vent piping, accessories, and components, from manufacturer.

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
2. Detailed description of piping anchorage devices on which the certification is based and their installation requirements.

C. Field quality control reports.

1.5 FIELD CONDITIONS

A. Interruption of Existing Sanitary Waste Service: Do not interrupt service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary service in accordance with requirements indicated:

1. Notify Architect no fewer than two days in advance of proposed interruption of sanitary waste service.
2. Do not proceed with interruption of sanitary waste service without Architect's written permission.

1.6 WARRANTY

A. Listed manufacturers to provide labeling and warranty of their respective products.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Minimum Working Pressure Ratings: Components and installation are capable of withstanding the following minimum working pressure requirements unless otherwise indicated:

1. Sanitary Waste and Vent Piping: 10 ft. head of water.
2. Sanitary Waste, Force-Main Piping: 150 psig.

2.2 SANITARY WASTE AND VENT PIPING MATERIALS

A. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, fitting materials, and joining methods for specific services, service locations, and pipe sizes.

2.3 PVC SANITARY WASTE AND VENT PIPE AND FITTINGS

A. Sanitary Waste and Vent Pipe, PVC:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Charlotte Pipe and Foundry Company
b. Cor-Tek; Atkore International
c. JM Eagle
d. National Pipe & Plastics; a CRH Company
e. Silver-line Plastics
f. Westlake Pipe & Fittings

2. Comply with NSF 14 for plastic piping components. Include "NSF-dwv" marking for plastic drain, waste, and vent piping and "NSF-sewer" marking for plastic sewer piping.
3. Solid Wall: ASTM D2665 drain, waste, and vent.
4. Cellular Core: ASTM F891, Schedule 40.

B. Sanitary Waste and Vent Fittings, PVC:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

   a. Charlotte Pipe and Foundry Company
   b. Mueller Streamline Co.; a company of Mueller Industries
   c. NIBCO INC.
   d. Westlake Pipe & Fittings

2. PVC Socket Fittings: ASTM D2665, manufactured in accordance with ASTM D3311; drain, waste, and vent patterns and to fit Schedule 40 pipe.

C. Adhesive Primer: ASTM F656.

1. Product Data: Verify adhesive primer has a VOC content of 550 g/L or less.
2. Product Data: Verify adhesive primer complies with testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
3. Product Data: Verify adhesive primer complies with testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers." Verify formaldehyde emissions do not exceed 9 mcg/cu. m or 7 ppb, whichever is less.
4. Product Data: Verify adhesive primer complies with testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers." Verify building concentration of formaldehyde does not exceed half of the indoor recommended exposure limit, or 33 mcg/cu. m, and that of acetaldehyde does not exceed 9 mcg/cu. m.

D. Solvent Cement: ASTM D2564.

1. Product Data: Verify PVC welding solvent cement has a VOC content of 510 g/L or less.

2.4 SANITARY WASTE AND VENT SPECIALTY PIPE FITTINGS

A. Sanitary Waste and Vent Piping Transition Coupling - Nonpressure, Shielded:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include,

but are not limited to, the following:

a. Dallas Specialty & Mfg. Co.
b. Fernco Inc
c. Mission Rubber Company, LLC

2. Standard: ASTM C1460.
3. Description: Elastomeric or rubber sleeve with full-length, corrosion-resistant outer shield, and corrosion-resistant-metal tension band and tightening mechanism on each end.
4. End Connections: Same size as and compatible with pipes to be joined.

B. Dielectric Union:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. A.Y. McDonald Mfg. Co.
b. HART Industrial Unions, LLC
c. Jomar Valve
d. Matco-Norca
e. WATTS; A Watts Water Technologies Company
f. Zurn Industries, LLC

2. Pressure Rating: 125 psig minimum at 180 deg F.
3. End Connections: Solder-joint copper alloy and threaded ferrous.
4. Standard: ASSE 1079.

C. Dielectric Flange:

1. Manufacturers: Subject to compliance with requirements, provide products by the following:

a. WATTS; A Watts Water Technologies Company
b. Zurn Industries, LLC

2. Description: Factory-fabricated, bolted, companion-flange assembly.
3. Pressure Rating: 125 psig minimum at 180 deg F.
4. End Connections: Solder-joint copper alloy and threaded ferrous.
5. Standard: ASSE 1079.

D. Single-Stack Drainage Fittings:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Conine Manufacturing Co., Inc
b. SE Sovent

2. Description: Cast-iron aerator and deaerator drainage fitting.
3. Standards:

    a. ASME B16.45 (Historical).
    b. CISPI 301.
    c. ASTM A126.

2.5 ENCASEMENT FOR UNDERGROUND METAL PIPING

A. Standard: ASTM A674 or AWWA C105/A21.5.

B. Material: Linear low-density polyethylene film of 0.008-inch or minimum thickness.

C. Form: tube.

D. Color: Black.

PART 3 - EXECUTION

3.1 EARTH MOVING

A. Comply with requirements for excavating, trenching, and backfilling specified in Section 312000 "Earth Moving."

3.2 INSTALLATION OF SANITARY WASTE AND VENT PIPING, GENERAL

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems.

1. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations.
2. Install piping as indicated unless deviations to layout are approved on coordination drawings.

B. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.

C. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

D. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

E. Install piping to permit valve servicing.

F. Install piping at indicated slopes.

G. Install piping free of sags and bends.

H. Install fittings for changes in direction and branch connections.

I. Install piping to allow application of insulation.

J. Install seismic restraints on piping. Comply with requirements for seismic-restraint devices specified in Section 220548.13 "Vibration Controls for Plumbing Piping and Equipment."

K. Make changes in direction for sanitary waste and vent piping using appropriate branches, bends, and long-sweep bends.

1. Sanitary tees and short-sweep one-fourth bends may be used on vertical stacks if change in direction of flow is from horizontal to vertical.
2. Use long-turn, double Y-branch, and one-eighth-bend fittings if two fixtures are installed back to back or side by side with common drain pipe.

    a. Straight tees, elbows, and crosses may be used on vent lines.
    b. Do not change direction of flow more than 90 degrees. Use the proper size of standard increasers and reducers if pipes of different sizes are connected. Reducing size of sanitary waste piping in direction of flow is prohibited.

L. Lay buried building sanitary waste piping beginning at low point of each system.

1. Install true to grades and alignment indicated, with unbroken continuity of invert. Place hub ends of piping upstream.
2. Install required gaskets according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements.
3. Maintain swab in piping and pull past each joint as completed.

M. Slope: Install sanitary waste and vent piping at the following minimum slopes unless otherwise indicated on Drawings:

1. Building Sanitary Waste Piping: Two percent downward in direction of flow for piping **NPS 3** and smaller; 12 percent downward in direction of flow for piping **NPS 4** and larger.
2. Horizontal Sanitary Waste Piping: Two percent downward in direction of flow.
3. Vent Piping: One percent down toward vertical fixture vent or toward vent stack.

N. Install engineered sanitary waste and vent piping systems as follows:

1. Combination Waste and Vent: Comply with standards of authorities having jurisdiction.
2. Hubless, Single-Stack Drainage System: Comply with ASME B16.45 (Historical) and hubless, single-stack drainage fitting manufacturer's written installation instructions.
3. Reduced-Size Venting: Comply with standards of authorities having jurisdiction.

O. Install force mains at elevations indicated.

P. Install heat tracing on grease waste piping.

1. Install heat tracing in accordance with Section 220533 "Heat Tracing for Plumbing Piping."

Q. Plumbing Specialties:

1. Install backwater valves in sanitary waster gravity-flow piping.

a. Comply with requirements for backwater valves specified in Section 221319 "Sanitary Waste Piping Specialties."

2. Install cleanouts at grade and extend to where building sanitary drains connect to building sanitary sewers in sanitary waste gravity-flow piping.

a. Install cleanout fitting with closure plug inside the building in sanitary drainage force-main piping.
b. Comply with requirements for cleanouts specified in Section 221319 "Sanitary Waste Piping Specialties."

3. Install drains in sanitary waste gravity-flow piping.

a. Comply with requirements for drains specified in Section 221319 "Sanitary Waste Piping Specialties."

4. Install piping and cleanouts to grease interceptors.

R. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.

S. Install sleeves for piping penetrations of walls, ceilings, and floors.

1. Comply with requirements for sleeves specified in Section 220500 "Common Work Results for Plumbing."

T. Install sleeve seals for piping penetrations of concrete walls and slabs.

1. Comply with requirements for sleeve seals specified in Section 220500 "Common Work Results for Plumbing."

U. Install escutcheons for piping penetrations of walls, ceilings, and floors.

V. Comply with requirements for escutcheons specified in Section 220500 "Common Work Results for Plumbing."

3.3 INSTALLATION OF PVC SANITARY WASTE AND VENT PIPE AND FITTINGS

A. Install aboveground PVC piping in accordance with ASTM D2665.

B. Install underground PVC piping in accordance with ASTM D2321.

C. Plastic, Nonpressure-Piping, Solvent-Cement Joints: Clean and dry joining surfaces. Join pipe and fittings in accordance with the following:

1. Comply with ASTM F402 for safe-handling practice of cleaners, primers, and solvent cements.
2. Join in accordance with ASTM D2855 and ASTM D2665 appendixes.

3.4 INSTALLATION OF SANITARY WASTE AND VENT SPECIALTY PIPE FITTINGS

A. Transition Couplings:

1. Install transition couplings at joints of piping with small differences in ODs.
2. In Waste Drainage Piping: Shielded, nonpressure transition couplings.
3. In Aboveground Force Main Piping: Fitting-type transition couplings.
4. In Underground Force Main Piping:

   a. NPS 1-1/2 (DN 40) and Smaller: Fitting-type transition couplings.
   b. NPS 2 (DN 50) and Larger: Pressure transition couplings.

B. Dielectric Fittings:

1. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.
2. Dielectric Fittings for NPS 2 (DN 50) and Smaller: Use dielectric unions.
3. Dielectric Fittings for NPS 2-1/2 to NPS 4 (DN 65 to DN 100): Use dielectric flanges.

3.5 INSTALLATION OF VALVES

A. General valve installation requirements for general-duty valve installation are specified in Section 220523 "General-Duty Valves for Plumbing Piping."

B. Shutoff Valves:

1. Install shutoff valve on each sewage pump discharge.
2. Install full-port ball valve for piping **NPS 2** and smaller.
3. Install gate valve for piping **NPS 2-1/2** and larger.

C. Check Valves: Install swing check valve, between pump and shutoff valve, on each sewage pump discharge.

D. Backwater Valves: Install backwater valves in piping subject to backflow.

1. Horizontal Piping: Horizontal backwater valves. Use normally closed type unless otherwise indicated in Shop Drawings.
2. Floor Drains: Drain outlet backwater valves unless drain has integral backwater valve.
3. Install backwater valves in accessible locations.
4. Comply with requirements for backwater valve specified in Section 221319 "Sanitary Waste Piping Specialties."

3.6 INSTALLATION OF HANGERS AND SUPPORTS

A. Comply with requirements for seismic-restraint devices specified in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment."

B. Comply with requirements for pipe hanger and support devices and installation specified in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment."

1. Install carbon steel pipe hangers for horizontal piping in noncorrosive environments.
2. Install stainless steel pipe hangers for horizontal piping in corrosive environments.
3. Install carbon steel pipe support clamps for vertical piping in noncorrosive environments.
4. Install stainless steel pipe support clamps for vertical piping in corrosive environments.
5. Vertical Piping: MSS Type 8 or Type 42 clamps.
6. Install individual, straight, horizontal piping runs:

    a. 100 Ft. (30 m) and Less: MSS Type 1, adjustable, steel clevis hangers.
    b. Longer Than 100 Ft. (30 m): MSS Type 43, adjustable roller hangers.
    c. Longer Than 100 Ft. (30 m) if Indicated: MSS Type 49, spring cushion rolls.

7. Multiple, Straight, Horizontal Piping Runs 100 Ft. (30 m) or Longer: MSS Type 44 pipe rolls. Support pipe rolls on trapeze.
8. Base of Vertical Piping: MSS Type 52 spring hangers.

C. Metal Tube/Pipe:

1. Install hangers with maximum horizontal spacing and minimum rod diameters, to comply with MSS SP-58, locally enforced codes, and requirements of authorities having jurisdiction, whichever are most stringent.
2. Support vertical runs to comply with MSS SP-58, locally enforced codes, and requirements of authorities having jurisdiction, whichever are most stringent.

D. Plastic Pipe:

1. Install hangers with maximum horizontal spacing and minimum rod diameters, to comply with manufacturer's written instructions, locally enforced codes, and requirements of authorities having jurisdiction, whichever are most stringent.
2. Support vertical runs to comply with manufacturer's written instructions, locally enforced codes, and requirements of authorities having jurisdiction, whichever are most stringent

E. Support horizontal piping and tubing within **12 inches** of each fitting , valve, and coupling.

3.7 PIPING CONNECTIONS

A. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Connect sanitary waste piping to exterior sanitary sewerage piping. Use transition fitting to join dissimilar piping materials.

C. Connect sanitary waste and vent piping to the following:

1. Plumbing Fixtures: Connect waste piping in sizes indicated, but not smaller than required by plumbing code.
2. Plumbing Fixtures and Equipment: Connect atmospheric vent piping in sizes indicated, but not smaller than required by authorities having jurisdiction.
3. Plumbing Specialties: Connect sanitary waste and vent piping in sizes indicated, but not smaller than required by plumbing code.
4. Install test tees (wall cleanouts) in conductors near floor and floor cleanouts with cover flush with floor.
5. Install horizontal backwater valves with cleanout cover flush with floor.
6. Comply with requirements for cleanouts and drains specified in Section 221319 "Sanitary Waste Piping Specialties."
7. Equipment: Connect waste piping as indicated.

    a. Provide shutoff valve if indicated and union for each connection.
    b. Use flanges instead of unions for connections **NPS 2-1/2** and larger.

D. Connect force-main piping to the following:

1. Sanitary Sewer: To exterior force main.
2. Sewage Pump: To sewage pump discharge.

E. Where installing piping adjacent to equipment, allow space for service and maintenance of equipment.

F. Make connections in accordance with the following unless otherwise indicated in Shop Drawings:

1. Install unions, in piping **NPS 2** and smaller, adjacent to each valve and at final connection to each piece of equipment.
2. Install flanges, in piping **NPS 2-1/2** and larger, adjacent to flanged valves and at final connection to each piece of equipment.

G. Make connections to grease interceptors, manholes, and cleanouts and install heat trace to piping.

3.8 IDENTIFICATION

A. Identify exposed sanitary waste and vent piping.

B. Comply with requirements for identification specified in Section 220553 "Identification for Plumbing Piping and Equipment."

3.9 FIELD QUALITY CONTROL

A. During installation, notify authorities having jurisdiction at least 24 hours before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction.

1. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.
2. Final Inspection: Arrange for final inspection by authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.

B. Reinspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for reinspection.

C. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.

D. Test sanitary waste and vent piping in accordance with procedures of authorities having jurisdiction or, in absence of published procedures, as follows:

1. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired.

    a. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.

2. Leave uncovered and unconcealed new, altered, extended, or replaced waste and vent piping until it has been tested and approved.

    a. Expose work that was covered or concealed before it was tested.

3. Roughing-in Plumbing Test Procedure: Test sanitary waste and vent piping except outside leaders on completion of roughing-in.

    a. Close openings in piping system and fill with water to point of overflow, but not less than **10 ft. head of water**.
    b. From 15 minutes before inspection starts to completion of inspection, water level must not drop.
    c. Inspect joints for leaks.

4. Finished Plumbing Test Procedure: After plumbing fixtures have been set and traps filled with water, test connections and prove they are gastight and watertight.

    a. Plug vent-stack openings on roof and building drains where they leave building. Introduce air into piping system equal to pressure of **1 inch wg**.
    b. Use U-tube or manometer inserted in trap of water closet to measure this pressure.
    c. Air pressure must remain constant without introducing additional air throughout period of inspection.
    d. Inspect plumbing fixture connections for gas and water leaks.

5. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
6. Prepare reports for tests and required corrective action.

E. Test force-main piping in accordance with procedures of authorities having jurisdiction or, in absence of published procedures, as follows:

1. Leave uncovered and unconcealed new, altered, extended, or replaced force-main piping until it has been tested and approved.

    a. Expose work that was covered or concealed before it was tested.

2. Cap and subject piping to static-water pressure of **50 psig** above operating pressure, without exceeding pressure rating of piping system materials.

    a. Isolate test source and allow to stand for four hours.
    b. Leaks and loss in test pressure constitute defects that must be repaired.

3. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
4. Prepare reports for tests and required corrective action.

F. Test grease waste piping and heat trace wiring.

3.10 CLEANING

A. Clean interior of piping. Remove dirt and debris as work progresses.

3.11 PROTECTION

A. Protect sanitary waste and vent piping during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.

B. Place plugs in ends of uncompleted piping at end of day and when work stops.

C. Exposed Plastic Piping: Protect PVC plumbing vents exposed to sunlight with two coats of water-based latex paint.

D. Repair damage to adjacent materials caused by waste and vent piping installation.

3.12 PIPING SCHEDULE

A. Flanges and unions may be used on aboveground pressure piping unless otherwise indicated in Shop Drawings.

B. Aboveground, sanitary waste piping **NPS 4** and smaller is to be the following:

1. Solid-wall ABS pipe, ABS socket fittings, and solvent-cemented joints.
2. Solid-wall PVC pipe, PVC socket fittings, and solvent-cemented joints.

3. Dissimilar Pipe-Material Couplings: Shielded, nonpressure transition couplings.

C. Aboveground, sanitary waste piping **NPS 5** and larger is to be the following:

1. Solid-wall PVC pipe, PVC socket fittings, and solvent-cemented joints.
2. Dissimilar Pipe-Material Couplings: Shielded, nonpressure transition couplings.

D. Aboveground, vent piping **NPS 4** is to be the following:

1. Solid-wall ABS pipe, ABS socket fittings, and solvent-cemented joints.
2. Solid-wall PVC pipe, PVC socket fittings, and solvent-cemented joints.
3. Dissimilar Pipe-Material Couplings: Shielded, nonpressure transition couplings.

E. Aboveground, vent piping **NPS 5** and larger is to be the following:

1. Solid-wall PVC pipe, PVC socket fittings, and solvent-cemented joints.
2. Dissimilar Pipe-Material Couplings: Unshielded, nonpressure transition couplings.

F. Underground, sanitary waste and vent piping **NPS 4** and smaller are to be the following:

1. Solid-wall ABS pipe, ABS socket fittings, and solvent-cemented joints.
2. Solid-wall PVC pipe, PVC socket fittings, and solvent-cemented joints.
3. Dissimilar Pipe-Material Couplings: Shielded, nonpressure transition couplings.

G. Underground, sanitary waste piping **NPS 5** and larger is to be the following:

1. Dissimilar Pipe-Material Couplings: Unshielded, nonpressure transition couplings.

H. Aboveground sanitary-sewage force mains **NPS 1-1/2 and NPS 2** are to be the following:

1. Drawn-temper copper tube, **Type L**; copper pressure fittings; and soldered joints.
2. Galvanized-steel pipe, pressure fittings, and threaded joints.

I. Aboveground sanitary-sewage force mains **NPS 2-1/2 to NPS 6** are to be the following:

1. Drawn-temper copper tube, **Type L**; copper pressure fittings; and soldered joints.
2. Galvanized-steel pipe, pressure fittings, and threaded joints.
3. Grooved-end, galvanized-steel pipe; grooved-joint, galvanized-steel-pipe fittings; and grooved joints.

J. Underground sanitary-sewage force mains **NPS 4** and smaller are to be the following:

1. Annealed -temper copper tube, **Type L**; wrought- copper pressure fittings; and soldered joints.
2. Ductile-iron, mechanical-joint piping and mechanical joints.
3. Ductile-iron, push-on-joint piping and push-on joints.
4. Ductile-iron, grooved-joint piping and grooved joints.
5. Fitting-type transition coupling for piping smaller than **NPS 1-1/2** and pressure

transition coupling for **NPS 1-1/2** and larger if dissimilar pipe materials.

K. Underground sanitary-sewage force mains **NPS 5** and larger are to be the following:

1. Drawn-temper copper tube, **Type L**; wrought- copper pressure fittings; and soldered joints.
2. Ductile-iron, mechanical-joint piping and mechanical joints.
3. Ductile-iron, push-on-joint piping and push-on joints.
4. Ductile-iron, grooved-joint piping and grooved joints.
5. Pressure transition couplings if dissimilar pipe materials.

END OF SECTION 22 13 16

SECTION 22 13 19 - SANITARY WASTE PIPING SPECIALTIES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Cleanouts.
2. Air-admittance valves.
3. Miscellaneous sanitary drainage piping specialties.

B. Related Requirements:

1. Section 076200 "Sheet Metal Flashing and Trim" for metal roof flashing assemblies.
2. Section 077200 "Roof Accessories" for preformed flashings.
3. Section 078413 "Penetration Firestopping" for through-penetration firestop assemblies.
4. Section 221323 "Sanitary Waste Interceptors" for metal and concrete interceptors outside the building, grease interceptors, grease-removal devices, oil interceptors, and solids interceptors.
5. Section 221423 "Storm Drainage Piping Specialties" for trench drains for storm water, channel drainage systems for storm water, roof drains, and catch basins.
6. Section 224300 "Healthcare Plumbing Fixtures" for plaster sink interceptors.
7. Section 334200 "Stormwater Conveyance" for storm drainage piping and piping specialties outside the building.

1.2 DEFINITIONS

A. ABS: Acrylonitrile butadiene styrene.

B. PVC: Polyvinyl chloride.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings:

1. Show fabrication and installation details for frost-resistant vent terminals.

1.4 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For sanitary waste piping specialties to include in emergency, operation, and maintenance manuals.

PART 2 - PRODUCTS

2.1 ASSEMBLY DESCRIPTIONS

A. Sanitary waste piping specialties shall bear label, stamp, or other markings of specified testing agency.

B. Comply with NSF 14 for plastic sanitary waste piping specialty components.

2.2 CLEANOUTS

A. Plastic Floor Cleanouts (Insert drawing designation, if any):

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

    a. Endura; a Canplas Industries company
    b. IPS Corporation
    c. NDS Inc
    d. Plastic Oddities
    e. Sioux Chief Manufacturing Company, Inc.
    f. Zurn Industries, LLC

2. Size: Same as connected branch.
3. Body: PVC.
4. Closure Plug: PVC.
5. Riser: Drainage pipe fitting and riser to cleanout of same material as drainage piping.

2.3 AIR-ADMITTANCE VALVES

A. Fixture Air-Admittance Valves (Insert drawing designation, if any):

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

    a. Oatey Co.
    b. Studor, Inc

2. Standard: ASSE 1051, Type A for single fixture or Type B for branch piping.
3. Housing: Plastic.

4. Operation: Mechanical sealing diaphragm.
5. Size: Same as connected fixture or branch vent piping.

2.4 MISCELLANEOUS SANITARY DRAINAGE PIPING SPECIALTIES

A. Open Drains:

1. Description: Shop or field fabricate from ASTM A74, Service Class, hub-and-spigot, cast-iron soil-pipe fittings. Include P-trap, hub-and-spigot riser section; and where required, increaser fitting joined with ASTM C564 rubber gaskets.
2. Size: Same as connected waste piping with increaser fitting of size indicated.

B. Deep-Seal Traps:

1. Description: Cast-iron or bronze casting, with inlet and outlet matching connected piping and cleanout trap-seal primer valve connection.
2. Size: Same as connected waste piping.

    a. **NPS 2**: **4-inch-** minimum water seal.
    b. **NPS 2-1/2** and Larger: **5-inch-** minimum water seal.

C. Floor-Drain, Trap-Seal Primer Fittings:

1. Description: Cast iron, with threaded inlet and threaded or spigot outlet, and trap-seal primer valve connection.
2. Size: Same as floor drain outlet with **NPS 1/2** side inlet.

D. Floor-Drain, Inline Trap Seal (Insert drawing designation, if any):

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

    a. Green Drain, Inc.
    b. Jay R. Smith Mfg Co; a division of Morris Group International
    c. Josam Company
    d. MIFAB, Inc
    e. RectorSeal Plumbing; A CSW Industrials Company

2. Description: Inline floor drain trap seal, forming a physical barrier to slow trap evaporation while not impeding flow from drain.
3. Material: Polymer.
4. Standard: Tested and certified in accordance with ASSE 1072.
5. Listing: ICC-ES or IAPMO listed.
6. Size: Same as floor drain outlet or strainer throat.

E. Air-Gap Fittings:

1. Standard: ASME A112.1.2, for fitting designed to ensure fixed, positive air gap between installed inlet and outlet piping.

2. Body: Bronze or cast iron.
3. Inlet: Opening in top of body.
4. Outlet: Larger than inlet.
5. Size: Same as connected waste piping and with inlet large enough for associated indirect waste piping.

F. Sleeve Flashing Device:

1. Description: Manufactured, cast-iron fitting, with clamping device that forms sleeve for pipe floor penetrations of floor membrane. Include galvanized-steel pipe extension in top of fitting that will extend 1 inch above finished floor and galvanized-steel pipe extension in bottom of fitting that will extend through floor slab.
2. Size: As required for close fit to riser or stack piping.

G. Stack Flashing Fittings:

1. Description: Counterflashing-type, cast-iron fitting, with bottom recess for terminating roof membrane, and with threaded or hub top for extending vent pipe.
2. Size: Same as connected stack vent or vent stack.

H. Vent Caps:

1. Description: Cast-iron body with threaded or hub inlet and vandal-proof design. Include vented hood and setscrews to secure to vent pipe.
2. Size: Same as connected stack vent or vent stack.

I. Frost-Resistant Vent Terminals:

1. Description: Manufactured or shop-fabricated assembly constructed of copper, lead-coated copper, or galvanized steel.
2. Design: To provide **1-inch** enclosed air space between outside of pipe and inside of flashing collar extension, with counterflashing.

J. Expansion Joints:

1. Standard: ASME A112.6.4.
2. Body: Cast iron with bronze sleeve, packing, and gland.
3. End Connections: Matching connected piping.
4. Size: Same as connected soil, waste, or vent piping.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install backwater valves in building drain piping.

1. For interior installation, provide cleanout deck plate flush with floor and centered over backwater valve cover, and of adequate size to remove valve cover for servicing.

B. Install cleanouts in aboveground piping and building drain piping according to the following, unless otherwise indicated:

1. Size same as drainage piping up to **NPS 4**. Use **NPS 4** for larger drainage piping unless larger cleanout is indicated.
2. Locate at each change in direction of piping greater than 45 degrees.
3. Locate at minimum intervals of **50 feet** for piping **NPS 4** and smaller and **100 feet** for larger piping.
4. Locate at base of each vertical soil and waste stack.

C. For floor cleanouts for piping below floors, install cleanout deck plates with top flush with finished floor.

D. For cleanouts located in concealed piping, install cleanout wall access covers, of types indicated, with frame and cover flush with finished wall.

E. Install fixture air-admittance valves on fixture drain piping.

F. Install stack air-admittance valves at top of stack vent and vent stack piping.

G. Install air-admittance-valve wall boxes recessed in wall.

H. Assemble open drain fittings and install with top of hub 1 inch above floor.

I. Install deep-seal traps on floor drains and other waste outlets, if indicated.

J. Install floor-drain, trap-seal primer fittings on inlet to floor drains that require trap-seal primer connection.

1. Exception: Fitting may be omitted if trap has trap-seal primer connection.
2. Size: Same as floor drain inlet.

K. Install air-gap fittings on draining-type backflow preventers and on indirect-waste piping discharge into sanitary drainage system.

L. Install sleeve and sleeve seals with each riser and stack passing through floors with waterproof membrane.

M. Install vent caps on each vent pipe passing through roof.

N. Install frost-resistant vent terminals on each vent pipe passing through roof. Maintain **1-inch** clearance between vent pipe and roof substrate.

O. Install expansion joints on vertical stacks and conductors. Position expansion joints for easy access and maintenance.

P. Install frost-proof vent caps on each vent pipe passing through roof. Maintain **1-inch** clearance between vent pipe and roof substrate.

Q. Install wood-blocking reinforcement for wall-mounting-type specialties.

R. Install traps on plumbing specialty drain outlets. Omit traps on indirect wastes unless

trap is indicated.

3.2 PIPING CONNECTIONS

A. Comply with requirements in Section 221316 "Sanitary Waste and Vent Piping" for piping installation requirements. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to equipment, to allow service and maintenance.

3.3 LABELING AND IDENTIFYING

A. Distinguish among multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations, in addition to identifying unit.

1. Nameplates and signs are specified in Section 220553 "Identification for Plumbing Piping and Equipment."

3.4 PROTECTION

A. Protect drains during remainder of construction period to avoid clogging with dirt or debris and to prevent damage from traffic or construction work.

B. Place plugs in ends of uncompleted piping at end of each day or when work stops.

END OF SECTION 22 13 19

SECTION 22 13 19.13 - SANITARY DRAINS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Floor drains.
2. Floor sinks.

B. Related Requirements:

1. Section 033000 "Cast-In-Place Concrete" for placing concrete at concrete trench drain-forming system.

1.2 DEFINITIONS

A. ABS: Acrylonitrile-butadiene styrene.

B. FRP: Fiberglass-reinforced plastic.

C. HDPE: High-density polyethylene.

D. PE: Polyethylene.

E. PP: Polypropylene.

F. PVC: Polyvinyl chloride.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Sanitary drains are to bear label, stamp, or other markings of specified testing agency.

B. Comply with NSF 14 for plastic sanitary piping specialty components.

2.2 FLOOR DRAINS

A. Floor Drain - Stainless Steel, ASME A112.6.3:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

    a. BLÜCHER; A Watts Water Technologies Company
    b. Jay R. Smith Mfg Co; a division of Morris Group International
    c. Josam Company
    d. MIFAB, Inc
    e. Sioux Chief Manufacturing Company, Inc.
    f. Wade; a subsidiary of McWane Inc.
    g. WATTS; A Watts Water Technologies Company
    h. Zurn Industries, LLC

2. Source Limitations: Obtain stainless steel floor drains, ASME A112.6.3, from single manufacturer.
3. Standard: ASME A112.6.3.
4. Body Material: Type 304 cast stainless steel.
5. Outlet: Bottom.
6. Top or Strainer Material: Stainless steel.
7. Top Shape: Round.
8. Dimensions of Top or Strainer: 6 inch minimum.
9. Seepage Flange: Not required.
10. Anchor Flange: Not required.
11. Clamping Device: Required.
12. Trap-Primer Connection: Required.
13. Trap Material: Cast iron.
14. Trap Pattern: Deep-seal P-trap.

2.3 FLOOR SINKS

A. Floor Sink - Cast Iron:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

    a. Jay R. Smith Mfg Co; a division of Morris Group International
    b. Josam Company
    c. MIFAB, Inc
    d. Wade; a subsidiary of McWane Inc.
    e. WATTS; A Watts Water Technologies Company
    f. Zurn Industries, LLC

2. Source Limitations: Obtain cast-iron floor sinks from single manufacturer.
3. Standard: ASME A112.6.7.
4. Pattern: Floor drain.

5. Body Material: Cast iron.
6. Anchor Flange: Not required.
7. Clamping Device: Required.
8. Outlet: Bottom, no-hub connection.
9. Coating on Interior Surfaces: Acid-resistant enamel.
10. Sediment Bucket: Not required.
11. Internal Strainer: Dome.
12. Internal Strainer Material: Aluminum.
13. Top of Body and Grate Finish: Acid-resistant enamel.
14. Top Grate Material: Cast iron , loose.
15. Top Shape: Square.
16. Top Loading Classification: No traffic.
17. Funnel: Not required.

PART 3 - EXECUTION

3.1 INSTALLATION OF FLOOR DRAINS

A. Install floor drains at low points of surface areas to be drained. Set grates of drains flush with finished floor.

1. Position floor drains for easy access and maintenance.
2. Set floor drains below elevation of surrounding finished floor to allow floor drainage.
3. Set with grates depressed according to the following drainage area radii:

    a. Radius, 30 Inches (750 mm) or Less: Equivalent to 1 percent slope, but not less than **1/4-inch** total depression.
    b. Radius, 30 to 60 Inches (750 to 1500 mm): Equivalent to 1 percent slope.
    c. Radius, 60 Inches (1500 mm) or Larger: Equivalent to 1 percent slope, but not greater than **1-inch** total depression.

4. Install floor-drain flashing collar or flange, so no leakage occurs between drain and adjoining flooring.

    a. Maintain integrity of waterproof membranes where penetrated.

5. Install individual traps for floor drains connected to sanitary building drain, unless otherwise indicated in a schedule or on Drawings.

3.2 INSTALLATION OF FLOOR SINKS

A. Install floor sinks where indicated on Drawings. Set grates of drains flush with finished floor.

1. Position floor sinks for easy access and maintenance.
2. Install floor sink flashing collar or flange, so that no leakage occurs between drain and adjoining flooring.

a. Maintain integrity of waterproof membranes where penetrated.

3. Install individual traps for floor sinks connected to sanitary building drain, unless otherwise indicated in a schedule or on Drawings.

3.3 PIPING CONNECTIONS

A. Comply with requirements in Section 221316 "Sanitary Waste and Vent Piping" for piping installation requirements. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Comply with requirements in Section 221319 "Sanitary Waste Piping Specialties" for backwater valves, air admittance devices, and miscellaneous sanitary drainage piping specialties.

C. Comply with requirements in Section 221323 "Sanitary Waste Interceptors" for grease interceptors, grease-removal devices, oil interceptors, sand interceptors, and solid interceptors.

D. Install piping adjacent to equipment to allow service and maintenance.

3.4 LABELING AND IDENTIFYING

A. Distinguish among multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations, in addition to identifying unit. Nameplates and signs are specified in Section 220553 "Identification for Plumbing Piping and Equipment."

3.5 PROTECTION

A. Protect drains during remainder of construction period to avoid clogging with dirt or debris and to prevent damage from traffic or construction work.

B. Place plugs in ends of uncompleted piping at end of each day or when work stops.

END OF SECTION 22 13 19.13

SECTION 221323 - SANITARY WASTE INTERCEPTORS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Interceptors, grease.
2. Precast-concrete manhole risers.
3. Manhole risers, frames, and covers.
4. Sampling ports.

1.2 ACTION SUBMITTALS

A. Product Data: For each type and size of sanitary waste interceptor.

1. Include materials of fabrication, dimensions, rated capacities, retention capacities, operating characteristics, size and location of each pipe connection, furnished specialties, and accessories.
2. Include diagrams of power wiring.

B. Shop Drawings: For each type and size of precast-concrete sanitary waste interceptor.

1. Include materials of construction, dimensions, rated capacities, retention capacities, location and size of each pipe connection, furnished specialties, and accessories.

1.3 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Interceptors, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:

1. Piping connections. Include size, location, and elevation of each.
2. Interface with underground structures and utility services.

1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For sanitary waste interceptors to include in emergency, operation, and maintenance manuals.

1.5 FIELD CONDITIONS

A. Interruption of Existing Sewer Services: Do not interrupt services to facilities occupied

by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary sewer services in accordance with requirements indicated:

1. Notify Architect no fewer than Insert number days in advance of proposed interruption of service.
2. Do not proceed with interruption of sewer services without Architect's written permission.

PART 2 - PRODUCTS

2.1 INTERCEPTORS, GREASE

A. Interceptors, Grease - Plastic:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

    a. MIFAB, Inc
    b. Rockford Separators
    c. Schier Products Company
    d. Zurn; Zurn Elkay

2. Standard:

    a. PDI G101.
    b. ASME A112.14.3.

3. Description: Factory-fabricated grease interceptor for intercepting and retaining FOG from food -preparation or -processing wastewater.
4. Body Material: Plastic.
5. Inlet, Outlet, and Vent Piping Connections: Hub, or no-hub (hubless) unless otherwise indicated.
6. Capacities and Characteristics:

    a. Length by Width by Depth: **87"x3**.
    b. Number of Compartments: One.
    c. Flow Rate: **250 gpm**.
    d. Retention Capacity: **500 lb**.
    e. Inlet and Outlet Pipe Size: **4" NPS**.
    f. Trapped Outlet: Integral.
    g. Cleanout: Integral or field installed on outlet.
    h. Vent Pipe Size: **3" NPS**.
    i. Mounting: Above floor.
    j. Flow-Control Fitting: Required.
    k. Operation: Manual cleaning.

2.2 SAMPLING PORTS

A. Sampling Ports - Plastic:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

    a. MIFAB, Inc
    b. Schier Products Company

2. Description: Factory-fabricated sampling port.
3. Body Material: Seamless rotationally molded polyethylene or molded HDPE.
4. Location: Below grade.
5. Cover: Water and gas-tight seal.

    a. Include indented top design with lettering cast into cover, using wording equivalent to " SAMPLING WELL/PORT ".

6. Structural Design Loads:

    a. Heavy-Traffic Load: Comply with ASTM C890, A-16.

PART 3 - EXECUTION

3.1 INSTALLATION OF SANITARY WASTE INTERCEPTORS

A. Equipment Mounting:

1. Install grease interceptors on cast-in-place concrete equipment base(s).
2. Comply with requirements for equipment bases and foundations specified in Section 033000 "Cast-in-Place Concrete."

B. Install precast-concrete interceptors in accordance with ASTM C891.

C. Set interceptors level and plumb.

D. Install manhole risers from top of underground concrete interceptors to manholes and gratings at finished grade.

E. Set tops of manhole frames and covers flush with finished surface in pavements.

1. Set tops 3 inches above finish surface elsewhere unless otherwise indicated.

F. Set tops of grating frames and grates flush with finished surface.

G. Set plastic interceptors level and plumb.

H. Set tops of metal interceptor covers flush with finished surface in pavements.

1. Set tops 3 inches above finish surface elsewhere unless otherwise indicated.

I. Install captured waste oil piping and waste oil storage tanks in accordance with the requirements of the Authority Having Jurisdiction.

J. Install grease interceptors, including trapping, venting, and flow-control fitting, in accordance with authorities having jurisdiction and with clear space for servicing.

1. Above-Floor Installation: Set unit with bottom resting on floor unless otherwise indicated.
2. Flush with Floor Installation: Set unit and extension, if required, with cover flush with finished floor.
3. Recessed Floor Installation: Set unit in receiver housing having bottom or cradle supports, with receiver housing cover flush with finished floor.
4. Install cleanout immediately downstream from interceptors not having integral cleanout on outlet.

K. Install grease-removal devices on floor. Install trap, vent, and flow-control fitting in accordance with authorities having jurisdiction.

1. Install control panel adjacent to unit unless otherwise indicated.

L. Install oil and sand & oil interceptors, including trapping, venting, and flow-control fitting, in accordance with authorities having jurisdiction and with clear space for servicing.

1. Coordinate captured waste oil storage tank and/or gravity drain with the Authority Having Jurisdiction.

M. Install solids interceptors with cleanout immediately downstream from interceptors that do not have integral cleanout on outlet.

1. Install trap on interceptors that do not have integral trap and are connected to sanitary drainage and vent systems.

END OF SECTION 221323

SECTION 22 14 29 - SUMP PUMPS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Sump-pump basins and basin covers.

B. Related Requirements:

1. Section 221329 "Sanitary Sewerage Pumps" for effluent and sewage pumps.

1.2 ACTION SUBMITTALS

A. Product Data:

1. Sump pumps - submersible.
2. Sump pumps - wet-pit volute.
3. Oil-sensing sump pumps and controllers.
4. Sump pumps - pedestal.
5. Sump-pump basins and basin covers.
6. Packaged drainage-pump units - submersible.

B. Product Data Submittals: For each product.

1. Construction details, material descriptions, dimensions of individual components and profiles.
2. Rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

C. Shop Drawings:

1. Include plans, elevations, sections, and mounting details.
2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
3. Include diagrams for power, signal, and control wiring.

1.3 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For pumps and controls.

1. Indicate actual installed items by marking submittals with an arrow or box.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Retain shipping flange protective covers and protective coatings during storage.

B. Protect bearings and couplings against damage.

C. Comply with manufacturer's written instructions for handling.

1.5 WARRANTY

A. Manufacturer Warranty: Manufacturer and Installer agree to repair or replace sump pumps that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Faulty operation of elevator sump pump system.
b. Deterioration of metals, metal finishes, and other materials beyond normal weathering.

2. Warranty Period: 1 year(s) from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 SOURCE LIMITATIONS

A. Obtain each type of sump pump from single source from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by an NRTL, and marked for intended location and use.

B. UL Compliance: Comply with UL 778 for motor-operated water pumps.

2.3 Submersible, Elevator Sump Pump

A. Basis-of-Design Product: Subject to compliance with requirements, provide Liberty or comparable product by one of the following:

1. Liberty Pumps

2.4 SUMP-PUMP BASINS AND BASIN COVERS

A. Basins sump: Factory-fabricated, watertight, cylindrical, basin sump with top flange and sidewall openings for pipe connections.

1. Material: Cast iron.
2. Reinforcement: Mounting plates for pumps, fittings, and accessories.
3. Anchor Flange: Same material as or compatible with basin sump, cast in or attached to sump, and in location and of size required to anchor basin in concrete slab.

B. Basin Covers: Fabricate metal cover with openings having gaskets, seals, and bushings; for access to pumps, pump shafts, control rods, discharge piping, vent connections, and power cables.

1. Reinforcement: Steel or cast iron, capable of supporting foot traffic for basins installed in foot-traffic areas.

C. Capacities and Characteristics: on drawings.

1. Cover Material: Cast iron.
2. Manhole Required in Cover: No.

2.5 MOTORS

A. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Section 220500 "Common Work Results for Plumbing."

1. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.

B. Motors for submersible pumps are to be hermetically sealed.

PART 3 - EXECUTION

3.1 EARTHWORK

A. Excavation and filling are specified in Section 312000 "Earth Moving."

3.2 EXAMINATION

A. Examine roughing-in for plumbing piping to verify actual locations of storm drainage piping connections before sump-pump installation.

3.3 INSTALLATION

A. Pump Installation Standards: Comply with HI 14.4 for installation of sump pumps.

B. Equipment Mounting:

1. Comply with requirements for vibration isolation and seismic control devices

specified in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment."

2. Comply with requirements for vibration isolation devices specified in Section 220548.13 "Vibration Controls for Plumbing Piping and Equipment."

C. Wiring Method: Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

D. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii. Provide and use lacing bars and distribution spools.

3.4 PIPING CONNECTIONS

A. Comply with requirements for piping specified in Section 221414 "Storm Drainage Piping." Drawings indicate general arrangement of piping, fittings, and specialties.

B. Where installing piping adjacent to equipment, allow space for service and maintenance.

3.5 STARTUP SERVICE

A. Perform startup service.

1. Complete installation and startup checks in accordance with manufacturer's written instructions.

3.6 ADJUSTING

A. Adjust pumps to function smoothly, and lubricate as recommended by manufacturer.

B. Adjust control set points.

3.7 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Manufacturer's Field Service: Engage a factory-authorized service representative to test, inspect, and adjust components, assemblies, and equipment installations, including connections.

C. Tests and inspections:

1. Perform each visual and mechanical inspection.
2. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
3. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.

4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
5. Pumps and controls will be considered defective if they do not pass tests and inspections.

D. Prepare test and inspection reports.

3.8 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain controls and pumps.

END OF SECTION 22 14 29

SECTION 22 33 00 - ELECTRIC, DOMESTIC-WATER HEATERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Domestic-water heater, electric - commercial, storage type.
2. Domestic-water heater, electric - residential, storage type.
3. Domestic-water heater accessories.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

B. Shop Drawings:

1. Include diagrams for power, signal, and control wiring.

C. Sustainable Design Submittals:

1.3 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Equipment room drawing or BIM model, drawn to scale, on which the items described in this Section are shown and coordinated with all building trades.

B. Seismic Qualification Certificates: For commercial domestic-water heaters, accessories, and components, from manufacturer.

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

C. Product Certificates: For each type of commercial residential, electric, domestic-water heater.

D. Domestic-Water Heater Labeling: Certified and labeled by testing agency acceptable to authorities having jurisdiction.

E. Source quality control reports.

F. Field quality control reports.

G. Sample warranties.

1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For electric, domestic-water heaters.

1.5 COORDINATION

A. Coordinate sizes and locations of concrete bases with actual equipment provided.

1.6 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of electric, domestic-water heaters that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Structural failures including storage tank and supports.
b. Faulty operation of controls.
c. Deterioration of metals, metal finishes, and other materials beyond normal use.

2. Warranty Periods: From date of Substantial Completion.

a. Commercial, Electric, Domestic-Water Heaters:

1) Tank: Three years.
2) Controls and Other Components: Three years.

b. Residential, Electric, Storage, Domestic-Water Heaters:

1) Tank: Five years.
2) Controls and Other Components: Two years.

c. Electric, Tankless, Domestic-Water Heaters: One year(s).
d. Expansion Tanks: Five years.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Electric domestic water heater equipment intended to convey or dispense water for

human consumption are to comply with the U.S. Safe Drinking Water Act, with requirements of authorities having jurisdiction, and with NSF 61 and NSF 372, or be certified in compliance with NSF 61 and NSF 372 by an ANSI-accredited third-party certification body, in that the weighted average lead content at wetted surfaces is less than or equal to 0.25 percent.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by an NRTL, and marked for intended location and use.

C. ASME Compliance: Where ASME-code construction is indicated, fabricate and label commercial, domestic-water heater storage tanks to comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.

D. NSF Compliance: Fabricate and label equipment components that will be in contact with potable water to comply with NSF 61 and NSF 372.

2.2 COMMERCIAL, ELECTRIC, DOMESTIC-WATER HEATERS

A. Domestic-Water Heater, Electric - Commercial, Storage Type:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

    a. A. O. Smith Corporation
    b. Bradford White Corporation

2. Source Limitations: Obtain domestic-water heaters, electric - commercial, storage type from single source from single manufacturer.
3. Standard: UL 1453.
4. Tank Construction: Non- ASME-code, steel vertical arrangement.

    a. Tappings: Factory fabricated of materials compatible with tank and piping connections. Attach tappings to tank before testing.

        1) NPS 2 (DN 50) and Smaller: Threaded ends in accordance with ASME B1.20.1.
        2) NPS 2-1/2 (DN 65) and Larger: Flanged ends in accordance with ASME B16.5 for steel and stainless steel flanges, and in accordance with ASME B16.24 for copper and copper-alloy flanges.

    b. Pressure Rating: 150 psig.
    c. Interior Finish: Comply with NSF 61 and NSF 372 barrier materials for potable-water tank linings, including extending lining material into tappings.

5. Factory-Installed, Tank Appurtenances:

    a. Anode Rod: Replaceable magnesium.
    b. Drain Valve: Corrosion-resistant metal with hose-end connection.
    c. Insulation: Comply with ASHRAE/IES 90.1.

d. Jacket: Steel with enameled finish or high-impact composite material.
e. Heating Elements: Electric, screw-in or bolt-on immersion type arranged in multiples of three.
f. Temperature Control: Adjustable thermostat.
g. Safety Controls: High-temperature-limit and low-water cutoff devices or systems.
h. Relief Valves: ASME rated and stamped for combination temperature-and-pressure relief valves. Include one or more relief valves with total relieving capacity at least as great as heat input, and include pressure setting less than working-pressure rating of domestic-water heater. Select one relief valve with sensing element that extends into storage tank.

6. Special Requirements: NSF 5 construction.

B. Capacity and Characteristics: see drawings.

2.3 RESIDENTIAL, ELECTRIC, DOMESTIC-WATER HEATERS

A. Domestic-Water Heater, Electric - Residential, Storage Type:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. A. O. Smith Corporation
b. Bradford White Corporation

2. Source Limitations: Obtain domestic-water heaters, electric - residential, storage type from single source from single manufacturer.
3. Standard: UL 174.
4. Tank Construction: Steel.

a. Tappings: ASME B1.20.1 pipe thread.
b. Pressure Rating: **150 psig**.
c. Interior Finish: Comply with NSF 61 and NSF 372 barrier materials for potable-water tank linings, including extending lining material into tappings.

5. Factory-Installed, Storage-Tank Appurtenances:

a. Anode Rod: Replaceable magnesium.
b. Dip Tube: Required unless cold-water inlet is near bottom of tank.
c. Drain Valve: Corrosion-resistant metal with hose-end connection.
d. Insulation: Comply with ASHRAE/IES 90.1.
e. Jacket: Steel, cylindrical, with enameled finish or high-impact composite material.
f. Heat-Trap Fittings: Inlet type in cold-water inlet and outlet type in hot-water outlet.
g. Heating Elements: Electric, screw-in immersion type.
h. Temperature Control: Adjustable thermostat.
i. Safety Control: High-temperature-limit cutoff device or system.

j. Relief Valve: ASME rated and stamped for combination temperature-and-pressure relief valves. Include relieving capacity at least as great as heat input, and include pressure setting less than working-pressure rating of domestic-water heater. Select relief valve with sensing element that extends into storage tank.

B. Capacity and Characteristics:

2.4 DOMESTIC-WATER HEATER ACCESSORIES

A. Domestic-Water Expansion Tanks:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

   a. A. O. Smith Corporation
   b. AMTROL, Inc.
   c. Taco Comfort Solutions

2. Source Limitations: Obtain domestic-water expansion tanks from single source from single manufacturer.
3. Description: Steel pressure-rated tank constructed with welded joints and factory-installed, butyl-rubber diaphragm. Include air precharge to minimum system-operating pressure at tank.
4. Construction:

   a. Tappings: Factory-fabricated steel, welded to tank before testing and labeling. Include ASME B1.20.1 pipe thread.
   b. Interior Finish: Comply with NSF 61 and NSF 372 barrier materials for potable-water tank linings, including extending finish into and through tank fittings and outlets.
   c. Air-Charging Valve: Factory installed.

5. Capacity and Characteristics:

   a. Working-Pressure Rating: 150 psig.

B. Drain Pans: Corrosion-resistant metal with raised edge. Include dimensions not less than base of domestic-water heater, and include drain outlet not less than **NPS 3/4** with ASME B1.20.1 pipe threads.

C. Piping-Type Heat Traps: Field-fabricated piping arrangement in accordance with ASHRAE/IES 90.1.

D. Heat-Trap Fittings: ASHRAE/IES 90.1.

E. Manifold Kits: Domestic-water-heater manufacturer's factory-fabricated inlet and outlet piping for field installation, for multiple domestic-water heater installation. Include ball-, butterfly-, or gate-type shutoff valves to isolate each domestic-water heater and

calibrated balancing valves to provide balanced flow through each domestic-water heater.

1. Comply with requirements for ball-, butterfly-, or gate-type shutoff valves specified in Section 220523 "General-Duty Valves for Plumbing Piping."
2. Comply with requirements for balancing valves specified in Section 221119 "Domestic Water Piping Specialties."

F. Pressure-Reducing Valves: ASSE 1003 for water. Set at **25-psig-** maximum outlet pressure unless otherwise indicated.

G. Combination Temperature-and-Pressure Relief Valves: ASME rated and stamped. Include relieving capacity at least as great as heat input, and include pressure setting less than working-pressure rating of domestic-water heater. Select relief valves with sensing element that extends into storage tank.

H. Pressure Relief Valves: ASME rated and stamped. Include pressure setting less than working-pressure rating of domestic-water heater.

I. Vacuum Relief Valves: ANSI Z21.22/CSA 4.4.

J. Shock Absorbers: ASSE 1010 or PDI-WH 201, Size A water hammer arrester.

K. Domestic-Water Heater Stands: Manufacturer's factory-fabricated steel stand for floor mounting, capable of supporting domestic-water heater and water. Include dimension that will support bottom of domestic-water heater a minimum of 18 inches above the floor.

L. Domestic-Water Heater Mounting Brackets: Manufacturer's factory-fabricated steel bracket for wall mounting, capable of supporting domestic-water heater and water.

2.5 SOURCE QUALITY CONTROL

A. Factory Tests: Test and inspect domestic-water heaters specified to be ASME-code construction, in accordance with ASME Boiler and Pressure Vessel Code.

B. Hydrostatically test commercial domestic-water heaters to minimum of one and one-half times pressure rating before shipment.

C. Electric, domestic-water heaters will be considered defective if they do not pass tests and inspections.

D. Prepare test and inspection reports.

PART 3 - EXECUTION

3.1 INSTALLATION OF ELECTRIC, DOMESTIC-WATER HEATERS

A. Commercial, Electric, Domestic-Water Heater Mounting: Install commercial, electric,

domestic-water heaters on concrete base. Comply with requirements for concrete bases specified in Section 033000 "Cast-in-Place Concrete."

1. Exception: Omit concrete bases for commercial, electric, domestic-water heaters if installation on stand, bracket, suspended platform, or directly on floor is indicated.
2. Maintain manufacturer's recommended clearances.
3. Arrange units so controls and devices that require servicing are accessible.
4. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on **18-inch** centers around the full perimeter of concrete base.
5. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
6. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
7. Install anchor bolts to elevations required for proper attachment to supported equipment.
8. Anchor domestic-water heaters to substrate.

B. Residential, Electric, Domestic-Water Heater Mounting: Install residential, electric, domestic-water heaters on water-heater stand on floor.

1. Maintain manufacturer's recommended clearances.
2. Arrange units so controls and devices that require servicing are accessible.
3. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
4. Install anchor bolts to elevations required for proper attachment to supported equipment.
5. Anchor domestic-water heaters to substrate.

C. Electric, Tankless, Domestic-Water Heater Mounting: Install electric, tankless, domestic-water heaters at least 18 inches above floor on wall bracket.

1. Maintain manufacturer's recommended clearances.
2. Arrange units so controls and devices that require servicing are accessible.
3. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
4. Install anchor bolts to elevations required for proper attachment to supported equipment.
5. Anchor domestic-water heaters to substrate.

D. Install electric, domestic-water heaters level and plumb, in accordance with layout drawings, original design, and referenced standards. Maintain manufacturer's recommended clearances. Arrange units so controls and devices needing service are accessible.

1. Install shutoff valves on domestic-water-supply piping to domestic-water heaters and on domestic-hot-water outlet piping. Comply with requirements for shutoff valves specified in Section 220523 "General-Duty Valves for Plumbing Piping."

E. Install commercial, electric, domestic-water heaters with seismic-restraint devices.

Comply with requirements for seismic-restraint devices specified in Section 220548.13 "Vibration Controls for Plumbing Piping and Equipment."

F. Install combination temperature-and-pressure relief valves in top portion of storage tanks. Use relief valves with sensing elements that extend into tanks. Extend domestic-water heater relief-valve outlet, with drain piping same as domestic-water piping in continuous downward pitch, and discharge by positive air gap onto closest floor drain.

G. Install combination temperature-and- pressure relief valves in water piping for electric, domestic-water heaters without storage. Extend domestic-water heater relief-valve outlet, with drain piping same as domestic-water piping in continuous downward pitch, and discharge by positive air gap onto closest floor drain.

H. Install water-heater drain piping as indirect waste to spill by positive air gap into open drains or over floor drains. Install hose-end drain valves at low points in water piping for electric, domestic-water heaters that do not have tank drains. Comply with requirements for hose-end drain valves specified in Section 221119 "Domestic Water Piping Specialties."

I. Install thermometers on outlet piping of electric, domestic-water heaters. Comply with requirements for thermometers specified in Section 220500 "Common Work Results for Plumbing."

J. Install thermometers on inlet and outlet piping of residential, solar, electric, domestic-water heaters. Comply with requirements for thermometers specified in Section 220500 "Common Work Results for Plumbing."

K. Assemble and install inlet and outlet piping manifold kits for multiple electric, domestic-water heaters. Fabricate, modify, or arrange manifolds for balanced water flow through each electric, domestic-water heater. Include shutoff valve and thermometer in each domestic-water heater inlet and outlet, and throttling valve in each electric, domestic-water heater outlet. Comply with requirements for valves specified in Section 220523 "General-Duty Valves for Plumbing Piping" and comply with requirements for thermometers specified in Section 220500 "Common Work Results for Plumbing."

L. Install pressure-reducing valve with integral bypass relief valve in electric, domestic-water booster-heater inlet piping and water hammer arrester in booster-heater outlet piping. Set pressure-reducing valve for outlet pressure of 25 psig. Comply with requirements for pressure-reducing valves and water hammer arresters specified in Section 221119 "Domestic Water Piping Specialties."

M. Install piping-type heat traps on inlet and outlet piping of electric, domestic-water heater storage tanks without integral or fitting-type heat traps.

N. Fill electric, domestic-water heaters with water.

O. Charge domestic-water expansion tanks with air to required system pressure.

P. Install dielectric fittings in all locations where piping of dissimilar metals is to be joined. The wetted surface of the dielectric fitting contacted by potable water to contain less than 0.25 percent of lead by weight.

3.2 PIPING CONNECTIONS

A. Comply with requirements for piping specified in Section 221116 "Domestic Water Piping." Drawings indicate general arrangement of piping, fittings, and specialties.

B. Where installing piping adjacent to electric, domestic-water heaters, allow space for service and maintenance of water heaters. Arrange piping for easy removal of domestic-water heaters.

3.3 IDENTIFICATION

A. Identify system components. Comply with requirements for identification specified in Section 220553 "Identification for Plumbing Piping and Equipment."

3.4 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

C. Perform tests and inspections with the assistance of a factory-authorized service representative.

D. Tests and Inspections:

1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
2. Operational Test: After electrical circuitry has been energized, start units to confirm proper operation.
3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

E. Electric, domestic-water heaters will be considered defective if they do not pass tests and inspections.

F. Prepare test and inspection reports.

3.5 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain commercial, electric, domestic-water heaters. Training to be a minimum of one hour(s).

END OF SECTION 22 33 00

SECTION 223400 - FUEL-FIRED, DOMESTIC-WATER HEATERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Commercial, direct-vent, gas-fired, storage, domestic-water heater.
2. Commercial, gas-fired, high-efficiency, storage, domestic-water heaters.
3. Gas-fired, tankless, domestic-water heaters.
4. Domestic-water heater accessories.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

B. Shop Drawings:

1. Include diagrams for power, signal, and control wiring.

1.3 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Equipment room drawing or BIM model, drawn to scale, on which the items described in this Section are shown and coordinated with all building trades.

B. Seismic Qualification Data: Certificates, for fuel-fired, domestic-water heaters, accessories, and components, from manufacturer.

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

C. Product Certificates: For each type of commercial, gas-fired, gas-fired, tankless, domestic-water heater.

D. Domestic-Water Heater Labeling: Certified and labeled by testing agency acceptable to authorities having jurisdiction.

E. Source quality-control reports.

F. Field quality-control reports.

G. Sample Warranty: For special warranty.

1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For fuel-fired, domestic-water heaters to include in emergency, operation, and maintenance manuals.

1.5 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of fuel-fired, domestic-water heaters that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Structural failures including storage tank and supports.
b. Faulty operation of controls.
c. Deterioration of metals, metal finishes, and other materials beyond normal use.

2. Warranty Periods: From date of Substantial Completion.

a. Commercial, Gas-Fired, Storage, Domestic-Water Heaters:

1) Storage Tank: Three years.
2) Controls and Other Components: One year(s).

b. Gas-Fired, Tankless, Domestic-Water Heaters:

1) Heat Exchanger: Five years.
2) Controls and Other Components: Three years.

c. Expansion Tanks: Five years.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by an NRTL, and marked for intended location and use.

B. ASHRAE/IES Compliance: Fabricate and label fuel-fired, domestic-water heaters to comply with ASHRAE/IES 90.1.

1. Comply with efficiency requirements in ASHRAE 189.1, which supersede requirements in ASHRAE/IESNA 90.1.

C. ASME Compliance:

1. Where ASME-code construction is indicated, fabricate and label commercial, domestic-water heater storage tanks to comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.
2. Where ASME-code construction is indicated, fabricate and label commercial, finned-tube, domestic-water heaters to comply with ASME Boiler and Pressure Vessel Code: Section IV.

D. NSF Compliance: Fabricate and label equipment components that will be in contact with potable water to comply with NSF 61 and NSF 372.

2.2 COMMERCIAL, GAS-FIRED, STORAGE, DOMESTIC-WATER HEATERS

A. Commercial, Direct-Vent, Gas-Fired, Storage, Domestic-Water Heaters:

B. Commercial, Gas-Fired, High-Efficiency, Storage, Domestic-Water Heaters:

2.3 DOMESTIC-WATER HEATER ACCESSORIES

A. Domestic-Water Expansion Tanks:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

    a. A. O. Smith Corporation
    b. Taco Comfort Solutions

2. Source Limitations: Obtain domestic-water heaters from single source from single manufacturer.
3. Description: Steel, pressure-rated tank constructed with welded joints and factory-installed, butyl-rubber diaphragm. Include air precharge to minimum system-operating pressure at tank.
4. Construction:

    a. Tappings: Factory-fabricated steel, welded to tank before testing and labeling. Include ASME B1.20.1 pipe thread.
    b. Interior Finish: Comply with NSF 61 and NSF 372 barrier materials for potable-water tank linings, including extending finish into and through tank fittings and outlets.
    c. Air-Charging Valve: Factory installed.

5. Capacity and Characteristics:

    a. Working-Pressure Rating: 150 psig.
    b. Capacity Acceptable: 4 gal. minimum.
    c. Air Precharge Pressure: 30.

B. Drain Pans: Corrosion-resistant metal with raised edge. Include dimensions not less than base of domestic-water heater, and include drain outlet not less than **NPS 3/4** with

ASME B1.20.1 pipe threads.

C. Piping-Type Heat Traps: Field-fabricated piping arrangement in accordance with ASHRAE/IES 90.1.

D. Heat-Trap Fittings: ASHRAE 90.2.

E. Manifold Kits: Domestic-water heater manufacturer's factory-fabricated inlet and outlet piping for field installation, for multiple domestic-water heater installation. Include ball-, butterfly-, or gate-type shutoff valves to isolate each domestic-water heater and calibrated balancing valves to provide balanced flow through each domestic-water heater.

F. Comply with requirements for ball-, butterfly-, or gate-type shutoff valves specified in Section 220523 "General-Duty Valves for Plumbing Piping."

1. Comply with requirements for balancing valves specified in Section 221119 "Domestic Water Piping Specialties."

G. Gas Shutoff Valves: ANSI Z21.15/CSA 9.1, manually operated. Furnish for installation in piping.

H. Gas Pressure Regulators: ANSI Z21.18/CSA 6.3, appliance type. Include 2-psig pressure rating as required to match gas supply.

I. Automatic Gas Valves: ANSI Z21.21/CSA 6.5, appliance, electrically operated, on-off automatic valve.

J. Combination Temperature-and-Pressure Relief Valves: Include relieving capacity at least as great as heat input, and include pressure setting less than working-pressure rating of domestic-water heater. Select relief valves with sensing element that extends into storage tank.

1. Gas-Fired, Domestic-Water Heaters: ANSI Z21.22/CSA 4.4.
2. Oil-Fired, Domestic-Water Heaters: ASME rated and stamped.

K. Pressure Relief Valves: Include pressure setting less than working-pressure rating of domestic-water heater.

1. Gas-Fired, Domestic-Water Heaters: ANSI Z21.22/CSA 4.4.
2. Oil-Fired, Domestic-Water Heaters: ASME rated and stamped.

L. Vacuum Relief Valves: ANSI Z21.22/CSA 4.4.

M. Domestic-Water Heater Stands: Manufacturer's factory-fabricated steel stand for floor mounting, capable of supporting domestic-water heater and water. Provide dimension that will support bottom of domestic-water heater minimum of 18 inches above the floor.

N. Domestic-Water Heater Mounting Brackets: Manufacturer's factory-fabricated steel bracket for wall mounting, capable of supporting domestic-water heater and water.

2.4 SOURCE QUALITY CONTROL

A. Factory Tests: Test and inspect assembled domestic-water heaters specified to be ASME-code construction, in accordance with ASME Boiler and Pressure Vessel Code.

B. Hydrostatically test commercial domestic-water heaters to minimum of one and one-half times pressure rating before shipment.

C. Domestic-water heaters will be considered defective if they do not pass tests and inspections.

D. Prepare test and inspection reports.

PART 3 - EXECUTION

3.1 INSTALLATION OF DOMESTIC-WATER HEATER

A. Commercial, Domestic-Water Heater Mounting: Install commercial domestic-water heaters on concrete base. Comply with requirements for concrete base specified in Section 033000 "Cast-in-Place Concrete."

1. Exception: Omit concrete bases for commercial domestic-water heaters if installation on stand, bracket, suspended platform, or directly on floor is indicated.
2. Maintain manufacturer's recommended clearances.
3. Arrange units so controls and devices that require servicing are accessible.
4. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on **18-inch** centers around the full perimeter of concrete base.
5. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
6. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
7. Install anchor bolts to elevations required for proper attachment to supported equipment.
8. Anchor domestic-water heaters to substrate.

B. Residential, Domestic-Water Heater Mounting: Install residential domestic-water heaters on floor.

1. Maintain manufacturer's recommended clearances.
2. Arrange units so controls and devices that require servicing are accessible.
3. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
4. Install anchor bolts to elevations required for proper attachment to supported equipment.
5. Anchor domestic-water heaters to substrate.

C. Tankless, Domestic-Water Heater Mounting: Install tankless, domestic-water heaters

at least 18 inches above floor on wall bracket.

1. Maintain manufacturer's recommended clearances.
2. Arrange units so controls and devices that require servicing are accessible.
3. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
4. Install anchor bolts to elevations required for proper attachment to supported equipment.
5. Anchor domestic-water heaters to substrate.

D. Install domestic-water heaters level and plumb, in accordance with layout drawings, original design, and referenced standards. Maintain manufacturer's recommended clearances. Arrange units so controls and devices needing service are accessible.

1. Install shutoff valves on domestic-water-supply piping to domestic-water heaters and on domestic-hot-water outlet piping. Comply with requirements for shutoff valves specified in Section 220523 "General-Duty Valves for Plumbing Piping."

E. Install gas-fired, domestic-water heaters in accordance with NFPA 54.

1. Install gas shutoff valves on gas supply piping to gas-fired, domestic-water heaters without shutoff valves.
2. Install gas pressure regulators on gas supplies to gas-fired, domestic-water heaters without gas pressure regulators if gas pressure regulators are required to reduce gas pressure at burner.
3. Install automatic gas valves on gas supplies to gas-fired, domestic-water heaters if required for operation of safety control.
4. Comply with requirements for gas shutoff valves, gas pressure regulators, and automatic gas valves specified in Section 231123 "Facility Natural-Gas Piping."

F. Install oil-fired, domestic-water heaters in accordance with NFPA 31.

1. Install shutoff valves on fuel-oil supply piping to oil-fired water-heater burners without shutoff valves. Comply with requirements for shutoff valves specified in Section 231113 "Facility Fuel-Oil Piping."

G. Install commercial domestic-water heaters with seismic-restraint devices. Comply with requirements for seismic-restraint devices specified in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment" and Section 220548.13 "Vibration Controls for Plumbing Piping and Equipment."

H. Install combination temperature-and-pressure relief valves in top portion of storage tanks. Use relief valves with sensing elements that extend into tanks. Extend domestic-water-heater relief-valve outlet, with drain piping same as domestic-water piping in continuous downward pitch, and discharge by positive air gap onto closest floor drain.

I. Install combination temperature-and- pressure relief valves in water piping for domestic-water heaters without storage. Extend domestic-water-heater relief-valve outlet, with drain piping same as domestic-water piping in continuous downward pitch, and discharge by positive air gap onto closest floor drain.

J. Install water-heater drain piping as indirect waste to spill by positive air gap into open drains or over floor drains. Install hose-end drain valves at low points in water piping for domestic-water heaters that do not have tank drains. Comply with requirements for hose-end drain valves specified in Section 221119 "Domestic Water Piping Specialties."

K. Install thermometer on outlet piping of domestic-water heaters. Comply with requirements for thermometers specified in Section 220500 "Common Work Results for Plumbing."

L. Assemble and install inlet and outlet piping manifold kits for multiple domestic-water heaters. Fabricate, modify, or arrange manifolds for balanced water flow through each domestic-water heater. Include shutoff valve and thermometer in each domestic-water heater inlet and outlet, and throttling valve in each domestic-water heater outlet. Comply with requirements for valves specified in Section 220523 "General-Duty Valves for Plumbing Piping" and comply with requirements for thermometers specified in Section 220500 "Common Work Results for Plumbing."

M. Install piping-type heat traps on inlet and outlet piping of domestic-water heater storage tanks without integral or fitting-type heat traps.

N. Fill domestic-water heaters with water.

O. Charge domestic-water expansion tanks with air to required system pressure.

P. Install dielectric fittings in all locations where piping of dissimilar metals is to be joined. The wetted surface of the dielectric fitting contacted by potable water shall contain less than 0.25 percent of lead by weight.

3.2 FIELD QUALITY CONTROL

A. Testing Agency:

1. Owner will engage a qualified testing agency to perform tests and inspections.
2. Engage a qualified testing agency to perform tests and inspections.

B. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

C. Perform tests and inspections with the assistance of a factory-authorized service representative.

D. Tests and Inspections:

1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
2. Operational Test: After electrical circuitry has been energized, start units to confirm proper operation.
3. Test and adjust controls and safeties. Replace damaged and malfunctioning

controls and equipment.

E. Domestic-water heaters will be considered defective if they do not pass tests and inspections.

F. Prepare test and inspection reports.

3.3 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain commercial, gas-fired, storage, gas-fired, tankless domestic-water heaters. Training shall be a minimum of two hour(s).

END OF SECTION 223400

SECTION 22 41 00 - RESIDENTIAL PLUMBING FIXTURES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Lavatories - counter mounted.
2. Lavatory faucets.
3. Showers - standard.
4. Shower faucets.
5. Kitchen sinks.
6. Water closets.
7. Toilet seats.
8. Supply fittings.
9. Waste fittings.
10. Grout.

B. Related Requirements:

1. Section 224200 "Commercial Plumbing Fixtures."
2. Section 224700 "Drinking Fountains and Water Coolers."

1.2 DEFINITIONS

A. PMMA: Polymethyl methacrylate, also known as "acrylic."

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for lavatories.
2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

B. Sustainable Design Submittals:

1. Plumbing Fixtures: Provide the following:

a. Manufacturer cut sheet indicating water consumption.
b. WaterSense certification for residential fixtures, commercial water closets, commercial urinals, and commercial showers.

C. Shop Drawings: Include diagrams for power, signal, and control wiring.

1.4 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Counter cutout templates for mounting of counter-mounted plumbing fixtures.

B. Sample Warranty: For special warranty.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For plumbing fixtures and faucets to include in emergency, operation, and operation and maintenance manuals.

1.6 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Faucet Washers and O-Rings: Equal to 10 percent of amount of each type and size installed.
2. Faucet Cartridges and O-Rings: Equal to 5 percent of amount of each type and size installed.
3. Flushometer-Tank Repair Kits: Equal to 5 percent of amount of each type installed, but no fewer than two of each type.
4. Toilet Seats: Equal to 5 percent of amount of each type installed.

1.7 WARRANTY

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS

A. Domestic water faucets intended to convey or dispense water for human consumption are to comply with the SDWA, requirements of authorities having jurisdiction, and NSF 61 and NSF 372, or to be certified in compliance with NSF 61 and NSF 372 by an American National Standards Institute (ANSI)-accredited third-party certification body that the weighted average lead content at wetted surfaces is less than or equal to 0.25 percent.

2.2 Water Closet Flange

A. Basis-of-Design Product: Subject to compliance with requirements, provide non-wax flange or comparable product by one of the following:

1. Oatey Co.
2.

2.3 LAVATORIES - COUNTER MOUNTED

A. Vitreous-China Lavatories:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

    a. American Standard
    b. Kohler Co
    c. TOTO USA, INC

B. Fixture:

1. Standard:

    a. ASME A112.19.1/CSA B45.2 for enameled cast-iron lavatories.
    b. IAPMO Z124.3/ANSI Z124.3 for PMMA lavatories.
    c. ASME A112.19.3/CSA B45.4 for stainless steel lavatories.
    d. ASME A112.19.2/CSA B45.1 for vitreous-china lavatories.

2. Type: Self-rimming.
3. Oval Nominal Size: 20 by 17 inches.
4. Rectangular Nominal Size: 18 by 15 inches.
5. Round Nominal Size: 19 inches in diameter.
6. Faucet-Hole Punching: Three holes, 2-inch centers.
7. Faucet-Hole Location: Rim.
8. Color: White.

C. Supply Fittings: Comply with requirements in "Supply Fittings" Article.

D. Waste Fittings: Comply with requirements in "Waste Fittings" Article.

2.4 LAVATORY FAUCETS

A. NSF Standard: Comply with NSF 61 and NSF 372 for faucet materials that will be in contact with potable water.

B. General-Duty, Solid-Brass Lavatory Faucets:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

    a. American Standard
    b. Chicago Faucets; Geberit Group
    c. Delta Faucet Company
    d. Elkay
    e. Moen Incorporated
    f. Price Pfister, Inc

g. Speakman Company
h. T&S Brass and Bronze Works, Inc.
i. TOTO USA, INC
j. Zurn Industries, LLC

C. Description: Include hot- and cold-water indicators; coordinate faucet inlets with supplies and fixture holes; coordinate outlet with spout and fixture receptor.

D. Standard: ASME A112.18.1/CSA B125.1.

E. Body Material: General duty, solid brass.

F. Finish: Polished chrome plate.

G. Maximum Flow Rate: 2.5 gpm.

H. Centers: 4 inches.

I. Mounting: Deck, concealed.

J. Valve Handle(s): Lever.

K. Inlet(s): NPS 3/8 tubing, with NPS 1/2 male adaptor.

L. Spout: Swivel, gooseneck.

M. Spout Outlet: Aerator.

N. Operation: Compression, manual.

O. Drain: Pop up.

2.5 SHOWERS - STANDARD

A. PMMA Shower, Standard, with Base and Faucet:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Acryline USA, Inc.
b. Anzzi; a brand of SWCorp
c. Aqua Bath Company, Inc.
d. Aquarius Bathware; a Praxis Company
e. Aquatic
f. Clarion Bathware
g. Comfort Designs Bathware
h. Jacuzzi Inc.
i. MAAX

B. Standard: IAPMO Z124.1.2/ANSI Z124.1.2.

C. Nominal Size: see drawings.

D. Surround:

1. One piece or sealed, multiple piece.
2. One piece.

E. Bathing Surface: Slip resistant.

F. Color: White.

G. Drain Location: Center.

2.6 SHOWER FAUCETS

A. NSF Standard: Comply with NSF 61 and NSF 372 for faucet materials that will be in contact with potable water.

B. Single-Handle, Thermostatic Faucets:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. American Standard
b. Lawler Manufacturing Company, Inc
c. POWERS; A Watts Water Technologies Company
d. ProFlo; a Ferguson Enterprises, Inc. brand

C. Fixture:

1. Description: Include hot- and cold-water indicators, check stops, and fixed showerhead, arm, and flange. Coordinate faucet inlets with supplies.
2. Standard: ASME A112.18.1/CSA B125.1 .
3. Body Material: Solid brass.
4. Finish: Polished chrome plate.
5. Maximum Flow Rate: 2.5 gpm unless otherwise indicated.
6. Mounting: Concealed.
7. Backflow-Prevention Device for Handheld Shower: Not required.
8. Operation: Compression, manual.
9. Antiscald Device: Integral with mixing valve.
10. Check Stops: Check-valve type, integral with or attached to body; on hot- and cold-water supply connections.

D. Supply Connections: NPS 1/2.

E. Shower Head:

1. Type: Ball joint.
2. Shower Head Material: Metallic with chrome-plated finish.
3. Spray Pattern: Adjustable.

4. Integral Volume Control: Not required.
5. Shower-Arm, Flow-Control Fitting: 2.0 gpm.

2.7 KITCHEN SINKS

A. Stainless Steel Kitchen Sink, Counter Mounted:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

    a. American Standard
    b. Elkay
    c. Sterling

B. Fixture:

1. ASME A112.19.1/CSA B45.2 for enameled -steel kitchen sinks.
2. IAMPO Z124.3/ANSI Z124.3 for PMMA kitchen sinks.
3. IAMPO Z124.3/ANSI Z124.3 for solid-surface kitchen sinks.
4. ASME A112.19.3/CSA B45.4 for stainless steel kitchen sinks.
5. Overall Dimensions: see drawings.
6. Metal Thickness: 0.050 inch.
7. Bowl:

    a. Dimensions: see drawings.
    b. Drain: **3-1/2-inch** crumb cup.

        1) Location: Centered in bowl.

C. Supply Fittings: Comply with requirements in "Supply Fittings" Article.

D. Waste Fittings: Comply with requirements in "Waste Fittings" Article, except include continuous waste for multibowl sinks.

1. Disposer: Not required.
2. Hot-Water Dispenser: Not required.

2.8 WATER CLOSETS

A. Water Closets: Floor mounted, floor outlet, close coupled (gravity tank), vitreous china, 1.6 gal./flush.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

    a. American Standard
    b. Kohler Co
    c. TOTO USA, INC

2. Bowl:

    a. Standards: ASME A112.19.2/CSA B45.1, ASME A112.19.5/CSA B45.15, and ASSE 1037/ASME A112.1060/CSA B125.16.
    b. Bowl Type: Siphon jet.
    c. Height: Standard Handicapped/elderly.
    d. Rim Contour: Elongated.
    e. Water Consumption: Low.
    f. Color: White.

3. Supply Fittings:

    a. Standard: ASME A112.18.1/CSA B125.1.
    b. Supply Piping: Chrome-plated-brass pipe or chrome-plated-copper tube matching water-supply piping size. Include chrome-plated wall flange.
    c. Stop: Chrome-plated-brass, one-quarter-turn, ball-type or compression stop with inlet connection matching water-supply piping type and size.

        1) Operation: Wheel handle.

    d. Riser:

        1) Size: NPS 1/2.
        2) Material: ASME A112.18.6/CSA 125.6, braided- or corrugated-stainless steel flexible hose riser.

2.9 TOILET SEATS

A. Toilet Seats:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

    a. American Standard
    b. Bemis Manufacturing Company
    c. Centoco Manufacturing Corporation
    d. Church Seats; Bemis Manufacturing Company

2. Standard: IAPMO Z124.5/ANSI Z124.5.
3. Material: Plastic.
4. Type: Commercial (Standard).
5. Shape: Elongated rim (Closed front).
6. Configuration: Closed front with cover.
7. Size: Elongated.
8. Hinge Type: Self-sustaining, check.
9. Hinge Material: Noncorroding metal.
10. Seat Cover: Required.
11. Color: White.

2.10 SUPPLY FITTINGS

A. NSF Standard: Comply with NSF 61 and NSF 372 for faucet materials that will be in contact with potable water.

B. Standard: ASME A112.18.1/CSA B125.1.

C. Bidet Lavatory Bar Sink Kitchen Sink and Laundry Tray Supply Fittings:

1. Supply Piping: Chrome-plated-brass pipe or chrome-plated-copper tube matching water-supply piping size. Include chrome-plated wall flange.
2. Stops: Chrome-plated-brass, one-quarter-turn, ball-type or compression stop with inlet connection matching water-supply piping type and size.

    a. Operation: Wheel handle.

3. Risers:

    a. Size:

        1) **NPS 3/8** for lavatories.
        2) NPS 1/2 for kitchen sinks.

    b. Material: ASME A112.18.6/CSA B125.6, braided- or corrugated-stainless-steel flexible hose riser.

2.11 WASTE FITTINGS

A. Standard: ASME A112.18.2/CSA B125.2.

B. Drain:

1. Grid type with **NPS 1-1/4** offset tailpiece for accessible lavatories.
2. Pop-up type with **NPS 1-1/4** straight tailpiece as part of faucet for standard lavatories.
3. Grid type with **NPS 1-1/2** offset tailpiece for accessible bar sinks and kitchen sinks.
4. Grid type with **NPS 1-1/2** straight tailpiece for standard kitchen sinks.

C. Trap:

1. Size:

    a. NPS 1-1/2 by NPS 1-1/4 for lavatories.
    b. **NPS 1-1/2** for kitchen sinks.

2. Material:

    a. Chrome-plated, two-piece, cast-brass trap and ground-joint swivel elbow with 0.032-inch- thick brass tube to wall; and chrome-plated-brass or -steel wall flange.

b. Stainless steel, two-piece trap and swivel elbow with **0.012-inch-** thick stainless steel tube to wall; and stainless steel wall flange.
c. ASTM F409 ABS or PVC two -piece trap and waste to wall and wall flange.

2.12 GROUT

A. Standard: ASTM C1107/C1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.

B. Characteristics: Nonshrink; recommended for interior and exterior applications.

C. Design Mix: **5000 psi**, 28-day compressive strength.

D. Packaging: Premixed and factory packaged.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine roughing-in of water-supply and sanitary drainage and vent piping systems to verify actual locations of piping connections before plumbing-fixture installation.

B. Examine walls, floors, cabinets, and counters for suitable conditions where fixtures will be installed.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION OF RESIDENTIAL PLUMBING FIXTURES

A. Install plumbing fixtures level and plumb in accordance with roughing-in drawings.

B. Install floor-mounted water closets on closet flange attachments to drainage piping.

C. Install counter-mounting fixtures in and attached to casework.

D. Install pedestal lavatories on pedestals and secured to wood blocking in wall.

E. Install water-supply piping with stop on each supply to each fixture to be connected to water distribution piping. Attach supplies to supports or substrate within pipe spaces behind fixtures. Install stops in locations where they can be easily reached for operation.

1. Use ball or gate valves if supply stops are not specified with fixture. Comply with valve requirements specified in Section 220523 "General-Duty Valves for Plumbing Piping."

F. Install tanks for accessible, tank-type water closets with lever handle mounted on wide side of compartment.

G. Install toilet seats on water closets.

H. Install faucet flow-control fittings with specified flow rates and patterns in faucet spouts if faucets are not available with required rates and patterns. Include adapters if required.

I. Install shower flow-control fittings with specified maximum flow rates in shower arms.

J. Install traps on fixture outlets.

1. Omit trap on fixtures with integral traps.
2. Omit trap on indirect wastes unless otherwise indicated.

K. Install disposer in outlet of each sink indicated to have a disposer. Install switch where indicated or in wall adjacent to sink if location is not indicated.

L. Install hot-water dispensers in back top surface of sink or in countertop with spout over sink.

M. Set shower receptors in leveling bed of cement grout.

N. Install protective shielding pipe covers and enclosures on exposed supplies and waste piping of accessible lavatories and sinks. Comply with requirements in Section 220719 "Plumbing Piping Insulation."

O. Install wall flanges or escutcheons at piping wall penetrations in exposed, finished locations. Use deep-pattern escutcheons if required to conceal protruding fittings. Comply with escutcheon requirements specified in Section 220500 "Common Work Results for Plumbing."

P. Seal joints between plumbing fixtures, counters, floors, and walls using sanitary-type, one-part, mildew-resistant silicone sealant. Match sealant color to fixture color. Comply with sealant requirements specified in Section 079200 "Joint Sealants."

3.3 PIPING CONNECTIONS

A. Connect fixtures with water supplies, stops, and risers, and with traps, soil, waste, and vent piping. Use size fittings required to match fixtures.

B. Comply with water piping requirements specified in Section 221116 "Domestic Water Piping."

C. Comply with soil and waste piping requirements specified in Section 221316 "Sanitary Waste and Vent Piping."

D. Install protective shielding pipe covers and enclosures on exposed supplies and waste piping of accessible lavatories and sinks. Comply with requirements in Section 220719 "Plumbing Piping Insulation."

3.4 ADJUSTING

A. Operate and adjust plumbing fixtures and controls. Replace damaged and malfunctioning fixtures, fittings, and controls.

B. Adjust water pressure at faucets to produce proper flow.

3.5 CLEANING AND PROTECTION

A. After completing installation of plumbing fixtures, inspect and repair damaged finishes.

B. Clean plumbing fixtures, faucets, and other fittings with manufacturers' recommended cleaning methods and materials.

C. Provide protective covering for installed plumbing fixtures and fittings.

D. Do not allow use of plumbing fixtures for temporary facilities unless approved in writing by Owner.

END OF SECTION 22 41 00

SECTION 22 42 00 - COMMERCIAL PLUMBING FIXTURES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Commercial showers.
2. Commercial sinks.
3. Commercial urinals.
4. Commercial water closets.
5. Toilet seats.

B. Related Requirements:

1. Section 114000 "Foodservice Equipment" for NSF-compliant foodservice and handwash sinks.
2. Section 224100 "Residential Plumbing Fixtures" for residential plumbing fixtures.

1.2 DEFINITIONS

A. FRP: Fiberglass-reinforced plastic.

B. High-Efficiency Flush Volume: **1.28 gal.** or less per flush.

C. PMMA: Polymethyl methacrylate; also known as "acrylic."

D. Standard-Efficiency Flush Volume: **1.6 gal.** per flush.

E. WaterSense Fixture: Water closet and/or flushometer valve/tank certified by the EPA to meet the WaterSense performance criteria.

1.3 ACTION SUBMITTALS

A. Product Data:

1. Include construction details, material descriptions and thicknesses, dimensions of individual components and profiles, and finishes for plumbing fixtures.
2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

B. Shop Drawings:

1. Plans, elevations, sections, and mounting details.
2. Details of equipment assemblies, including accessories. Indicate dimensions, weights, loads, required clearances, method of field assembly, components,

location and size of each field connection, location and size of each cutout, and anchorage provisions and attachment methods. Indicate coordination requirements for adjacent and interfacing Work.

3. Diagrams for power, signal, and control wiring.

C. Sustainable Design Submittals:

1. Plumbing Fixtures: Provide the following:

a. Manufacturer cut sheet indicating water consumption.
b. WaterSense certification for residential fixtures, commercial water closets, commercial urinals, and commercial showers.

1.4 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Counter cutout templates for mounting of counter-mounted lavatories and/or counter-mounted sinks.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data:

1. For lavatories and faucets.

a. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:

1) Servicing and adjustments of automatic faucets.

2. For shower valves to include in maintenance manuals.
3. For sinks and faucets to include in operation and maintenance manuals.

a. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:

1) Servicing and adjustments of automatic faucets.

4. For flushometer valves to include in operation and maintenance manuals.
5. For wash fountains and components to include in operation and maintenance manuals.

1.6 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials to Owner that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Faucet Washers and O-Rings: Equal to 10 percent of amount of each type and size installed.
2. Faucet Cartridges and O-Rings: Equal to 5 percent of amount of each type and

size installed.

3. Shower Valve Washers and O-Rings: Equal to 10 percent of amount of each type and size installed.
4. Shower Valve Cartridges and O-Rings: Equal to 5 percent of amount of each type and size installed.
5. Waterless Urinal Trap-Seal Cartridges: Equal to 200 percent of amount of each type installed, but no fewer than 12 of each type.
6. Waterless Urinal Trap-Seal Liquid: Equal to 1 gal. for each urinal installed.
7. Flushometer-Valve Repair Kits: Equal to 10 percent of amount of each type installed, but no fewer than one of each type.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Lavatory faucets, sink faucets, shower valves, and wash fountain spray heads and faucets intended to convey or dispense water for human consumption are to comply with the U.S. Safe Drinking Water Act (SDWA), with requirements of the Authority Having Jurisdiction (AHJ), and with NSF 61 and NSF 372, or be certified in compliance with NSF 61 and NSF 372 by an ANSI-accredited third-party certification body, in that the weighted average lead content at wetted surfaces is less than or equal to 0.25 percent.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.2 COMMERCIAL LAVATORIES

A. Lavatories, Wall Mounted:

1. Lavatories, Wall Mounted - Vitreous China, Rectangular with Back:

a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1) American Standard
2) Kohler Co
3) Sloan Valve Company
4) Zurn Industries, LLC

b. Fixture:

1) Standard: ASME A112.19.2/CSA B45.1.
2) Type: For wall hanging.
3) Nominal Size: Rectangular, see drawings.
4) Faucet-Hole Punching: Three holes, 2-inch centers.

5) Faucet-Hole Location: Top.
6) Color: White.
7) Mounting Material: Chair carrier.

c. Faucet: solid brass.
d. Support: Lavatory carrier, framing affixed,concealed arm.
e. Lavatory Mounting Height: Accessible in accordance with ICC A117.1.

2.3 COMMERCIAL SHOWERS

A. Grout:

1. Standard: ASTM C1107/C1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.
2. Characteristics: Nonshrink; recommended for interior and exterior applications.
3. Design Mix: **5000 psi**, 28-day compressive strength.
4. Packaging: Premixed and factory packaged.

2.4 COMMERCIAL SINKS

A. Service Sinks, Floor Mounted:

1. Service Sinks, Floor Mounted - Molded Stone:

a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1) Fiat Products
2) Florestone Products Co., Inc.

b. Source Limitations: Obtain sinks from single source from single manufacturer.
c. Fixture:

1) Standard: ASME A112.18.2/CSA B125.2.
2) Shape: Square.
3) Nominal Size: 24 by 24 inches.
4) Height: 10 inches.
5) Rim Guard: On all top surfaces.
6) Color: Not applicable.
7) Drain: Grid with NPS 2 outlet.

d. Mounting: On floor and flush to wall.
e. Faucet: with hook and hose connection.

B. Kitchen/Utility Sinks:

1. Kitchen/Utility Sinks, Freestanding - Stainless Steel:

a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

    1) Advance Tabco
    2) Elkay
    3) Just Manufacturing

b. Source Limitations: Obtain sinks from single source from single manufacturer.
c. Fixture:

    1) Standards:

        a) ASME A112.19.3/CSA B45.4.
        b) NSF 2.

    2) Type: Stainless steel, freestanding, sound-deadened unit with backsplash.
    3) Number of Compartments: Three.
    4) Overall Dimensions: see drawings.
    5) Material: 14 gauge, Type 304 stainless steel.
    6) Compartment:

        a) Dimensions: see drawings.
        b) Drain: Grid with NPS 1-1/2 tailpiece and twist drain.
        c) Drain Location: Centered in compartment.

    7) Each Compartment:

        a) Dimensions: see drawings.
        b) Drains: Grid with NPS 1-1/2 tailpiece and twist drain.
        c) Drain Location: Centered in compartment.

    8) Integral Drainboard(s): Both side(s).

        a) Dimensions Each: Not applicable.

d. Legs and Feet: Stainless steel tubing legs with adjustable bullet feet.
e. Faucet(s): shall reach all three compartments.

    1) Number Required: One.
    2) Mounting: On backsplash.

f. Supply Fittings:

    1) Standard: ASME A112.18.1/CSA B125.1.
    2) Supplies: Chrome-plated brass compression stop with inlet connection matching water-supply piping type and size.

        a) Operation: Wheel handle.

b) Risers: **NPS 1/2**, ASME A112.18.6/CSA B125.6, braided or corrugated stainless steel flexible hose.

g. Waste Fittings:

1) Standard: ASME A112.18.2/CSA B125.2.
2) Trap(s) Size: NPS 1-1/2.
3) Trap(s) Material:

a) Chrome-plated, two-piece, cast-brass trap and ground-joint swivel elbow with 17-gauge brass tube to wall; and chrome-plated brass or steel wall flange.
b) Stainless steel, two-piece trap and swivel elbow with **0.012-inch-** thick stainless steel tube to wall; and stainless steel wall flange.

4) Continuous Waste:

a) Size: NPS 1-1/2.
b) Material: Chrome-plated, 17-gauge brass tube.

C. Handwash Sinks:

1. Handwash Sinks - Stainless Steel:

a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1) Advance Tabco
2) Eagle Group
3) Elkay
4) Just Manufacturing
5) Sloan Valve Company

b. Source Limitations: Obtain sinks from single source from single manufacturer.
c. Fixture:

1) Standards:

a) ASME A112.19.3/CSA B45.4.
b) NSF 61.

2) Type: Wall-mounted stainless steel basin with radius corners, back for faucet, and support brackets.
3) Overall Dimensions: 17 by 16 by 5 inches.
4) Material: 18 gauge, Type 304 stainless steel.

d. Faucet: gooseneck brass.
e. Supply Fittings: Comply with requirements in "Sink Supply Fittings"

Paragraph.
f. Waste Fittings: Comply with requirements in "Sink Waste Fittings" Paragraph.
g. Support: Sink carrier, framing affixed.
h. Mounting Height: Accessible in accordance with ICC A117.1.

D. Sink Faucets, Manually Operated:

1. Sink Faucets, Manually Operated: Single control, mixing.

a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1) American Standard
2) Chicago Faucets; Geberit Group
3) Elkay
4) Just Manufacturing
5) Kohler Co
6) Speakman Company
7) T&S Brass and Bronze Works, Inc.
8) Zurn Industries, LLC

b. Source Limitations: Obtain sink faucets from single source from single manufacturer.
c. Standards:

1) ASME A112.18.1/CSA B125.1.
2) NSF 61.
3) NSF 372.

d. Description: Include hot- and cold-water indicators; coordinate faucet inlets with supplies and fixture hole punchings; coordinate outlet with spout and sink receptor.
e. Body Type: Centerset.
f. Body Material: Commercial, solid-brass, or die-cast housing with brazed copper and brass waterway.
g. Finish: Chrome plated.
h. Maximum Flow Rate: 2.5 gpm.
i. Mounting Type: Deck, concealed.
j. Valve Handle(s): 6-inch wrist blade.
k. Spout Type: Swivel, gooseneck.
l. Vacuum Breaker: Not required for hose outlet.
m. Spout Outlet: Aerator.

2. Sink Faucets, Manually Operated - Service Sink:

a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1) Acorn Engineering Company; a Division of Morris Group International
2) Chicago Faucets; Geberit Group
3) Fiat Products
4) Just Manufacturing
5) Kohler Co
6) ProFlo; a Ferguson Enterprises, Inc. brand
7) Speakman Company
8) T&S Brass and Bronze Works, Inc.
9) Zurn Industries, LLC

b. Source Limitations: Obtain sink faucets from single source from single manufacturer.
c. Description: Wall/back mounted, brass body, with integral service stops, checks, spout with bucket/pail hook, **3/4-inch** hose thread end, integral vacuum breaker, inlets **8 inches** o.c., and two-handle mixing.
d. Faucet:

1) Standards:

a) ASME A112.18.1/CSA B125.1.
b) NSF 61 and NSF 372.
c) ICC A117.1.
d) ASSE 1001 (VB).

2) Finish: Rough chrome plated.
3) Handles: 6-inch wrist blade.
4) Cartridges: Ceramic.
5) Brace: Adjustable top brace.

e. Vacuum Breaker: Required for hose outlet.
f. Spout Outlet: Hose thread in accordance with ASME B1.20.7.

E. Sink Supply Fittings:

1. NSF Standards: Comply with NSF 61 and NSF 372 for supply-fitting materials that will be in contact with potable water.
2. Standard: ASME A112.18.1/CSA B125.1.
3. Supply Piping: Chrome-plated brass pipe or chrome-plated copper tube matching water-supply piping size. Include chrome-plated brass or stainless steel wall flange.
4. Supply Stops: Chrome-plated brass, one-quarter-turn, ball-type or compression valve with inlet connection matching supply piping.
5. Operation: Wheel handle.

a. Risers Sizes: NPS 1/2.
b. Risers Material: ASME A112.18.6/CSA B125.6, braided or corrugated stainless steel flexible hose.

F. Sink Waste Fittings:

1. Standard: ASME A112.18.2/CSA B125.2.

2. Drain: Grid type with **NPS 1-1/2** offset and straight tailpiece.
3. Trap:

    a. Size: **NPS 1-1/2**.
    b. Material: Chrome-plated, two-piece, cast-brass trap and ground-joint swivel elbow with 17-gauge brass tube to wall; and chrome-plated brass or steel wall flange.

G. Grout:

1. Standard: ASTM C1107/C1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.
2. Characteristics: Nonshrink; recommended for interior and exterior applications.
3. Design Mix: **5000 psi**, 28-day compressive strength.
4. Packaging: Premixed and factory packaged.

2.5 COMMERCIAL URINALS

A. Urinals, Waterless:

1. Urinals, Waterless - Vitreous China, Wall Hung, Back Outlet:

    a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

        1) Kohler Co
        2) Sloan Valve Company
        3) Zurn Industries, LLC

    b. Fixture:

        1) Standard: ASME A112.19.2/CSA B45.1, except without water supply.
        2) Designed for liquid-trap-seal operation.
        3) Trap-Seal Method: Proprietary cartridge with liquid seal.
        4) Outlet Size and Location: NPS 2 flange; back.
        5) Trap-Sealing Liquid: Proprietary.
        6) Color: White.

    c. Waste Fitting:

        1) Standard: ASME A112.18.2/CSA B125.2 for transition coupling, trap, and waste pipe.
        2) Size: NPS 2.

    d. Support: Urinal carrier, floor affixed with steel uprights with fixture support plates and coupling with seal and fixture bolts and hardware matching fixture.
    e. Urinal Mounting Height: Accessible in accordance with ICC A117.1.

2.6 COMMERCIAL WATER CLOSETS

A. Water Closets, Floor Mounted:

1. Water Closets, Floor Mounted - Bottom Outlet, Top Spud:

a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1) American Standard
2) Kohler Co
3) Sloan Valve Company
4) TOTO USA, INC
5) Zurn Industries, LLC

b. Source Limitations: Obtain water closets from single source from single manufacturer.
c. Standard: ASME A112.19.2/CSA B45.1.
d. Bowl:

1) Material: Vitreous china.
2) Type: Siphon jet.
3) Style: Flushometer valve.
4) Height: Standard Accessible in accordance with ICC A117.1.
5) Rim Contour: Elongated.
6) Water Consumption: 1.6 gal. per flush.
7) Spud Size and Location: **NPS 1-1/2**; top.
8) Color: White.

e. Flushometer Valve: diaphram type.
f. Toilet Seat: self-sustaining with SS hinge.

2.7 COMMERCIAL WASH FOUNTAINS

2.8 TOILET SEATS

A. Toilet Seats - Commercial:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. American Standard
b. Bemis Manufacturing Company
c. Church Seats; Bemis Manufacturing Company
d. Kohler Co
e. TOTO USA, INC
f. Zurn Industries, LLC

2. Source Limitations: Obtain toilet seat from single source from single

manufacturer.
3. Standard: IAPMO/ANSI Z124.5.
4. Material: Plastic.
5. Type: Commercial (heavy duty).
6. Shape: Elongated rim, open front.
7. Hinge: Self-sustaining, check.
8. Hinge Material: Noncorroding metal.
9. Seat Cover: Not required.
10. Color: White.
11. Surface Treatment: Not required.

2.9 Mixing Valves - Thermostatic for Automated Faucets

A. Basis-of-Design Product: Subject to compliance with requirements, provide mixing valve as scheduled or comparable product by one of the following:

1. ProFlo; a Ferguson Enterprises, Inc. brand
2. TOTO USA, INC

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine roughing-in of water-supply piping and sanitary drainage and vent piping systems to verify actual locations of piping connections before plumbing fixture installation.

B. Examine walls and floors for suitable conditions where plumbing fixtures will be installed.

C. Examine counters for suitable conditions where lavatories and sinks will be installed.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION OF COMMERCIAL PLUMBING FIXTURES

A. Lavatory Installation:

1. Install lavatories level and plumb in accordance with roughing-in drawings.
2. Install supports, affixed to building substrate, for wall-mounted lavatories.
3. Install accessible, wall-mounted lavatories at mounting height in accordance with ICC A117.1.
4. Install water-supply piping with stop on each supply to each lavatory faucet. Install stops in locations that are accessible for ease of operation.
5. Install trap and waste piping on each drain outlet of each lavatory to be connected to sanitary drainage system.
6. Install wall flanges or escutcheons at piping wall penetrations in exposed, finished locations. Use deep-pattern escutcheons if required to conceal

protruding fittings. Comply with escutcheon requirements specified in Section 220500 "Common Work Results for Plumbing."

7. Seal joints between lavatories, counters, and walls using sanitary-type, one-part, mildew-resistant silicone sealant. Match sealant color to fixture color. Comply with sealant requirements specified in Section 079200 "Joint Sealants."
8. Install protective shielding pipe covers and enclosures on exposed supplies and waste piping of accessible lavatories. Comply with requirements in Section 220719 "Plumbing Piping Insulation."

B. Shower Installation:

1. Assemble shower components in accordance with manufacturers' written instructions.
2. Install showers level and plumb in accordance with roughing-in drawings.
3. Install ball or gate valves in water-supply piping to the shower if supply stops are specified with the shower valve. Comply with ball or gate valve requirements specified in Section 220523 "General Duty Valves for Plumbing Piping." Install valves in locations that are accessible for ease of operation.
4. Install shower flow-control fittings with specified maximum flow rates in shower arms.
5. Set shower receptors in leveling bed of cement grout.
6. Install wall flanges or escutcheons at piping wall penetrations in exposed, finished locations. Use deep-pattern escutcheons if required to conceal protruding fittings. Comply with escutcheon requirements specified in Section 220500 "Common Work Results for Plumbing."
7. Showers, except Cast-Polymer Showers: Seal joints between showers, floors, and walls using sanitary-type, one-part, mildew-resistant silicone sealant. Match sealant color to fixture color. Comply with sealant requirements specified in Section 079200 "Joint Sealants."
8. Cast-Polymer Showers: Adhere panels to drywall using shower manufacturer's recommended adhesive. Seal joints, between panels and between panels and adjacent drywall, using shower manufacturer's recommended caulking specific for each application. Match sealant to fixture color.

C. Sink Installation:

1. Install sinks level and plumb in accordance with roughing-in drawings.
2. Install supports, affixed to building substrate, for wall-mounted sinks.
3. Install accessible, wall-mounted sinks at mounting height in accordance with ICC A117.1.
4. Set floor-mounted sinks in leveling bed of cement grout.
5. Install water-supply piping with stop on each supply to each sink faucet.

    a. Exception: Use ball or gate valves if supply stops are not specified with sink. Comply with valve requirements specified in Section 220523 "General Duty Valves for Plumbing Piping."
    b. Install stops/valves in locations that are accessible for ease of operation.

6. Install trap and waste piping on each drain outlet of each sink to be connected to sanitary drainage system.
7. Install wall flanges or escutcheons at piping wall penetrations in exposed,

finished locations. Use deep-pattern escutcheons if required to conceal protruding fittings. Comply with escutcheon requirements specified in Section 220500 "Common Work Results for Plumbing."

8. Seal joints between sinks, counters, floors, and walls using sanitary-type, one-part, mildew-resistant silicone sealant. Match sealant color to fixture color. Comply with sealant requirements specified in Section 079200 "Joint Sealants."
9. Install protective shielding pipe covers and enclosures on exposed supplies and waste piping of accessible sinks. Comply with requirements in Section 220719 "Plumbing Piping Insulation."

D. Urinal Installation:

1. Install urinals level and plumb in accordance with roughing-in drawings.
2. Install wall-hung, back-outlet urinals onto waste-fitting seals and attached to supports.
3. Install wall-hung, bottom-outlet urinals with tubular waste piping attached to supports.
4. Install accessible, wall-mounted urinals at mounting height in accordance with ICC A117.1.
5. Install trap-seal liquid in waterless urinals.
6. Install supports, affixed to building substrate, for wall-hung urinals.
7. Use off-floor carriers with waste fitting and seal for back-outlet urinals.
8. Use carriers without waste fitting for urinals with tubular waste piping.
9. Use chair-type carrier supports with rectangular steel uprights for accessible urinals.
10. Measure support height installation from finished floor, not structural floor.
11. Install flushometer-valve, water-supply fitting on each supply to each urinal.
12. Attach supply piping to supports or substrate within pipe spaces behind fixtures.
13. Install lever-handle flushometer valves for accessible urinals with handle mounted on open side of compartment.
14. Install actuators in locations easily reachable for people with disabilities.
15. Install new batteries in battery-powered, electronic-sensor mechanisms.
16. Install wall flanges or escutcheons at piping wall penetrations in exposed, finished locations. Install deep-pattern escutcheons if required to conceal protruding fittings. Comply with escutcheon requirements specified in Section 220500 "Common Work Results for Plumbing."
17. Seal joints between urinals, walls, and floors using sanitary-type, one-part, mildew-resistant silicone sealant. Match sealant color to urinal color. Comply with sealant requirements specified in Section 079200 "Joint Sealants."

E. Water Closet Installation:

1. Install water closets level and plumb in accordance with roughing-in drawings.
2. Install floor-mounted water closets on bowl-to-drain connecting fitting attachments to piping or building substrate.
3. Install accessible, wall-mounted water closets at mounting height in accordance with ICC A117.1.
4. Install supports, affixed to building substrate, for floor-mounted, back-outlet water closets.
5. Use carrier supports with waste-fitting assembly and seal.
6. Install floor-mounted, back-outlet water closets, attached to building floor

substrate, onto waste-fitting seals; and attach to support.
7. Install wall-mounted, back-outlet water-closet supports with waste-fitting assembly and waste-fitting seals, and affix to building substrate.
8. Measure support height installation from finished floor, not structural floor.
9. Install flushometer-valve, water-supply fitting on each supply to each water closet.
10. Attach supply piping to supports or substrate within pipe spaces behind fixtures.
11. Install lever-handle flushometer valves for accessible water closets with handle mounted on open side of water closet.
12. Install actuators in locations easily reachable for people with disabilities.
13. Install new batteries in battery-powered, electronic-sensor mechanisms.
14. Install toilet seats on water closets.
15. Install wall flanges or escutcheons at piping wall penetrations in exposed, finished locations. Install deep-pattern escutcheons if required to conceal protruding fittings. Comply with escutcheon requirements specified in Section 220500 "Common Work Results for Plumbing."
16. Seal joints between water closets, walls, and floors using sanitary-type, one-part, mildew-resistant silicone sealant. Match sealant color to water-closet color. Comply with sealant requirements specified in Section 079200 "Joint Sealants."

F. Wash Fountain Installation:

1. Install wash fountains level and plumb in accordance with roughing-in drawings.
2. Set freestanding wash fountains on floor.
3. Install off-floor carrier supports, affixed to building substrate, for wall-mounted wash fountains.
4. Install accessible, wall-mounted wash fountains at mounting height in accordance with ICC A117.1.
5. Install water-supply piping with shutoff valve on each supply to each wash fountain faucet. Use ball or gate valves if supply stops are not specified with wash fountain. Comply with valve requirements specified in Section 220523 "General Duty Valves for Plumbing Piping." Install stops/valves in locations that are accessible for ease of operation.
6. Install trap and waste piping on each drain outlet of each wash fountain to be connected to sanitary drainage system.
7. Install wall flanges or escutcheons at piping wall penetrations in exposed, finished locations. Use deep-pattern escutcheons if required to conceal protruding fittings. Comply with escutcheon requirements specified in Section 220500 "Common Work Results for Plumbing."
8. Seal joints between wash fountains, floors, and walls using sanitary-type, one-part, mildew-resistant silicone sealant. Match sealant color to fixture color. Comply with sealant requirements specified in Section 079200 "Joint Sealants."
9. Install protective shielding pipe covers and enclosures on exposed supplies and waste piping of accessible sinks. Comply with requirements in Section 220719 "Plumbing Piping Insulation."

3.3 INSTALLATION OF PIPING CONNECTIONS

A. Connect plumbing fixtures with water supplies and soil, waste, and vent piping. Use size fittings required to match plumbing fixtures.

B. Comply with water piping requirements specified in Section 221116 "Domestic Water Piping."

C. Comply with soil, waste, and vent piping requirements specified in Section 221316 "Sanitary Waste and Vent Piping."

D. Install protective-shielding pipe covers and enclosures on exposed supplies and waste piping of accessible plumbing fixtures. Comply with requirements in Section 220719 "Plumbing Piping Insulation."

E. Where installing piping adjacent to water closets and urinals, allow space for service and maintenance.

3.4 INSTALLATION OF ELECTRICAL CONNECTIONS

A. Connect wiring in accordance with Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

B. Ground equipment in accordance with Section 260526 "Grounding and Bonding for Electrical Systems."

C. Install electrical devices furnished by manufacturer, but not factory mounted in accordance with NFPA 70 and NECA 1.

D. Install nameplate for each electrical connection, indicating electrical equipment designation and circuit number feeding connection.

1. Nameplate to be laminated acrylic or melamine plastic signs, as specified in Section 260553 "Identification for Electrical Systems."
2. Nameplate to be laminated acrylic or melamine plastic signs with a black background and engraved white letters at least 1/2 inch high.

3.5 INSTALLATION OF CONTROL CONNECTIONS

A. Install control and electrical power wiring to field-mounted control devices.

B. Connect control wiring in accordance with Section 260523 "Control-Voltage Electrical Power Cables."

3.6 ADJUSTING

A. Operate and adjust plumbing fixtures and controls. Replace damaged and malfunctioning plumbing fixtures, fittings, and controls.

B. Adjust water pressure at faucets to produce proper flow.

C. Adjust water pressure at shower valves to produce proper flow.

D. Adjust water pressure at flushometer valves to produce proper flow.

E. Install new batteries in battery-powered, electronic-sensor mechanisms.

3.7 CLEANING AND PROTECTION

A. After completing installation of plumbing fixtures, inspect and repair damage to finishes. Replace any fixtures unable to be repaired to the satisfaction of the Architect.

B. Clean plumbing fixtures and associated faucets, valves, flushometer valves, and fittings with manufacturers' recommended cleaning methods and materials.

C. Provide protective covering for installed plumbing fixtures and associated faucets, valves, flushometer valves, and fittings.

D. Do not allow use of plumbing fixtures for temporary facilities unless approved in writing by Owner.

END OF SECTION 22 42 00

SECTION 22 47 00 - DRINKING FOUNTAINS AND WATER COOLERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Water coolers.

1.2 ACTION SUBMITTALS

A. Product Data:

1. For each type of product.

a. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
b. Include operating characteristics, and furnished specialties and accessories.

B. Shop Drawings:

1. Include plans, elevations, sections, and attachment details.
2. Include details of fixture assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
3. Include diagrams for power wiring.

C. Delegated Design Submittals: For vibration isolation and supports, indicated to comply with performance requirements and design criteria, including analysis data .

D. Sustainable Design Submittals:

1.3 INFORMATIONAL SUBMITTALS

A. Seismic Qualification Certificates: For remote water coolers, accessories, and components, from manufacturer.

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For drinking fountains, water coolers, bottle filling stations, to include in maintenance manuals.

1. In addition to items specified in Section 017823 "Operation and Maintenance Data," include servicing and adjustment of electronic-sensor fixtures.

1.5 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Comply with manufacturer's written instructions for delivery, storage, and handling.

1.7 WARRANTY

A. Manufacturer Warranty: Manufacturer and Installer agree to repair or replace drinking fountains water coolers bottle filling stations that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Deterioration of metals, metal finishes, and other materials beyond normal weathering.

B. Warranty Period: One year(s) from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Standards:

1. Drinking fountains, water coolers, bottle filling stations, and remote water coolers intended to convey or dispense water for human consumption are to comply with the U.S. Safe Drinking Water Act (SDWA), requirements of the authority having jurisdiction, and with NSF 61 or NSF 372, or be certified in compliance with NSF 61 or NSF 372 by an ANSI-accredited third-party certification body, that the weighted average lead content at wetted surfaces is less than or equal to 0.25 percent.

2.2 WATER COOLERS

A. Water Coolers - Surface Wall Mounted, Stainless Steel:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

    a. Elkay
    b. Halsey Taylor
    c. Murdock Manufacturing; A Division of Morris Group International
    d. Oasis International

2. Source Limitations: Obtain surface wall-mounted, stainless steel, water coolers from single source from single manufacturer.
3. Standards:

    a. NSF 61.
    b. NSF 372.
    c. ASME A112.19.3/CSA B45.4.
    d. ASHRAE 18.
    e. UL 399.
    f. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

4. Type: Vandal resistant.
5. Bubbler: One, with adjustable stream regulator, located on each cabinet deck.
6. Control: Push bar.
7. Glass filler.
8. Bottle Filler: Sensor activation , with: Fill rate is 0.5 to 1.5 gpm.
9. Drain: Grid with **NPS 1-1/4** tailpiece.
10. Supply: **NPS 3/8** with shutoff valve.
11. Waste Fitting: ASME A112.18.2/CSA B125.2, **NPS 1-1/4** brass P-trap.
12. Filter: One or more water filters with capacity sized for unit peak flow rate.

    a. Standards:

        1) NSF 42.
        2) NSF 53.

13. Cooling System: Electric, with hermetically sealed compressor, cooling coil, air-cooled condensing unit, corrosion-resistant tubing, refrigerant, corrosion-resistant-metal storage tank, and adjustable thermostat.
14. Support: Fixture carrier.
15. Water-Cooler Mounting Height: High/low - standard/accessible in accordance with ICC A117.1.
16. Capacities and Characteristics:

    a. Cooled Water: 8 gph.
    b. Ambient-Air Temperature: **90 deg F**.

c. Inlet-Water Temperature: **80 deg F**.
d. Cooled-Water Temperature: **50 deg F**.
e. Electrical Characteristics:

1) Volts: 120 V ac.
2) Phase: Single.
3) Hertz: 60 Hz.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine roughing-in for water-supply and sanitary drainage and vent piping systems to verify actual locations of piping connections before fixture installation.

B. Examine walls and floors for suitable conditions where fixtures will be installed.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install fixtures level and plumb in accordance with roughing-in drawings. For fixtures indicated for juveniles, install at height required by authorities having jurisdiction.

B. Set pedestal drinking fountains and bottle filling stations on flat surface in accordance with manufacturer's written installation instructions.

C. Set freestanding water coolers on floor.

D. Install recessed drinking fountains and bottle filling stations secured to wood blocking in wall construction.

E. Install off-the-floor carrier supports, affixed to building substrate, for wall-mounted fixtures.

F. Install mounting frames, affixed to building construction, and attach recessed water coolers and bottle filling stations to mounting frames.

G. Set remote water coolers on floor unless otherwise indicated.

1. Comply with requirements for vibration isolation and seismic-control devices specified in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment."
2. Comply with requirements for vibration isolation devices specified in Section 220548.13 "Vibration Controls for Plumbing Piping and Equipment."

H. Install water-supply piping with shutoff valve on supply to each fixture to be connected to domestic-water distribution piping. Use ball or gate valve. Install valves in locations where they can be easily reached for operation. Valves are specified in Section 220523

"General-Duty Valves for Plumbing Piping."

I. Install trap and waste piping on drain outlet of each fixture to be connected to sanitary drainage system.

J. Install wall flanges or escutcheons at piping wall penetrations in exposed, finished locations. Use deep-pattern escutcheons where required to conceal protruding fittings. Comply with escutcheon requirements specified in Section 220500 "Common Work Results for Plumbing."

K. Seal joints between fixtures and walls using sanitary-type, one-part, mildew-resistant, silicone sealant. Match sealant color to fixture color. Comply with sealant requirements specified in Section 079200 "Joint Sealants."

3.3 PIPING CONNECTIONS

A. Connect fixtures with water supplies, stops, and risers, and with traps, soil, waste, and vent piping. Use size fittings required to match fixtures.

B. Comply with water piping requirements specified in Section 221116 "Domestic Water Piping."

C. Install ball or gate shutoff valve on water supply to each fixture. Install ball or gate valves with valved bypass on water connections to remote water coolers. Install valve upstream from filter for drinking fountain, water cooler, and bottle filling station. Comply with valve requirements specified in Section 220523 "General-Duty Valves for Plumbing Piping."

D. Comply with soil and waste piping requirements specified in Section 221316 "Sanitary Waste and Vent Piping."

3.4 ELECTRICAL CONNECTIONS

A. Connect wiring in accordance with Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

B. Ground equipment in accordance with Section 260526 "Grounding and Bonding for Electrical Systems."

C. Install electrical devices furnished by manufacturer, but not factory mounted, in accordance with NFPA 70 and NECA 1.

D. Install nameplate for each electrical connection, indicating electrical equipment designation and circuit number feeding connection.

1. Nameplates to be laminated acrylic or melamine plastic signs, as specified in Section 260553 "Identification for Electrical Systems."
2. Nameplates to be laminated acrylic or melamine plastic signs with a black background and engraved white letters at least **1/2 inch** high.

3.5 ADJUSTING

A. Adjust fixture flow regulators for proper flow and stream height.

B. Adjust water cooler temperature settings.

C. Adjust electronic-sensor settings.

3.6 CLEANING

A. After installing fixtures, inspect unit. Remove paint splatters and other spots, dirt, and debris. Repair damaged finish to match original finish.

B. Clean fixtures, on completion of installation, in accordance with manufacturer's written instructions.

C. Provide protective covering for installed fixtures.

D. Do not allow use of fixtures for temporary facilities unless approved in writing by Owner.

END OF SECTION 22 47 00

SECTION 23 05 00 - COMMON WORK RESULTS FOR HVAC

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Motors.
2. Grout.
3. Silicone sealants.

1.2 DEFINITIONS

A. Existing Piping To Remain: Existing piping that is not to be removed and that is not otherwise indicated to be removed, removed and salvaged, or removed and reinstalled.

1.3 ACTION SUBMITTALS

A. Product Data:

1. For each type of product, excluding motors which are included in Part 1 of HVAC equipment Sections.

    a. Include construction details, material descriptions, and dimensions of individual components, and finishes.
    b. Include operating characteristics and furnished accessories.

B. Delegated Design Submittals: For each anchor and alignment guide, including analysis data, signed and sealed by the qualified professional engineer responsible for their preparation.

1. Design Calculations: Calculate requirements for thermal expansion of piping systems and for selecting and designing expansion joints, loops, and swing connections.
2. Anchor Details: Detail fabrication of each anchor indicated. Show dimensions and methods of assembly and attachment to building structure.
3. Alignment Guide Details: Detail field assembly and attachment to building structure.
4. Schedule: Indicate type, manufacturer's number, size, material, pressure rating, end connections, and location for each expansion joint.

C. Sustainable Design Submittals:

1.4 INFORMATIONAL SUBMITTALS

A. Product Certificates: For each type of meter.

B. Welding certificates.

C. Field quality-control reports.

1.5 CLOSEOUT SUBMITTALS

1.6 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel in accordance with AWS D1.1/D1.1M.

B. Pipe and Pressure-Vessel Welding Qualifications: Qualify procedures and operators in accordance with 2021 ASME Boiler and Pressure Vessel Code, Section IX.

1.7 COORDINATION

A. Coordinate features of motors, installed units, and accessory devices to be compatible with the following:

1. Motor controllers.
2. Torque, speed, and horsepower requirements of the load.
3. Ratings and characteristics of supply circuit and required control sequence.
4. Ambient and environmental conditions of installation location.

PART 2 - PRODUCTS

2.1 MOTORS

A. Motor Requirements, General:

1. Content includes motors for use on alternating-current power systems of up to 600 V and installed at equipment manufacturer's factory or shipped separately by equipment manufacturer for field installation.
2. Comply with requirements in this Section except when stricter requirements are specified in equipment schedules or Sections.
3. Comply with NEMA MG 1 unless otherwise indicated.
4. Comply with IEEE 841 for severe-duty motors.

B. Motor Characteristics:

1. Duty: Continuous duty at ambient temperature of 40 deg C and at altitude of **3300 ft.** above sea level.
2. Capacity and Torque Characteristics: Sufficient to start, accelerate, and operate connected loads at designated speeds, at installed altitude and environment, with indicated operating sequence, and without exceeding nameplate ratings or

considering service factor.

C. Polyphase Motors:

1. Description: NEMA MG 1, Design B, medium induction motor.
2. Efficiency: Premium Efficient, as defined in NEMA MG 1.
3. Service Factor: 1.15.
4. Multispeed Motors: Variable torque.

    a. For motors with 2:1 speed ratio, consequent pole, single winding.
    b. For motors with other than 2:1 speed ratio, separate winding for each speed.

5. Multispeed Motors, Two Winding: Separate winding for each speed.
6. Rotor: Random-wound, squirrel cage.
7. Bearings: Regreasable, shielded, antifriction ball bearings suitable for radial and thrust loading.
8. Temperature Rise: Match insulation rating.
9. Insulation: Class F.
10. Code Letter Designation:

    a. Motors 15 Hp and Larger: NEMA starting Code F or Code G.
    b. Motors Smaller Than 15 Hp: Manufacturer's standard starting characteristic.

11. Enclosure Material: Cast iron for motor frame sizes 324T and larger; rolled steel for motor frame sizes smaller than 324T.

D. Additional Requirements for Polyphase Motors:

1. Motors Used with Reduced-Voltage and Multispeed Controllers: Match wiring connection requirements for controller with required motor leads. Provide terminals in motor terminal box, suited to control method.
2. Motors Used with Variable-Frequency Controllers: Ratings, characteristics, and features coordinated with and approved by controller manufacturer.

    a. Windings: Copper magnet wire with moisture-resistant insulation varnish, designed and tested to resist transient spikes, high frequencies, and short time-rise pulses produced by pulse-width-modulated inverters.
    b. Premium-Efficient Motors: Class B temperature rise; Class F insulation.
    c. Inverter-Duty Motors: Class F temperature rise; Class H insulation.
    d. Thermal Protection: Comply with NEMA MG 1 requirements for thermally protected motors.

3. Severe-Duty Motors: Comply with IEEE 841, with 1.15 minimum service factor.

E. Single-Phase Motors:

1. Motors larger than 1/20 hp must be one of the following, to suit starting torque and requirements of specific motor application:

a. Permanent-split capacitor.
b. Split phase.
c. Capacitor start, inductor run.
d. Capacitor start, capacitor run.

2. Multispeed Motors: Variable-torque, permanent-split-capacitor type.
3. Bearings: Prelubricated, antifriction ball bearings or sleeve bearings suitable for radial and thrust loading.
4. Motors 1/20 hp and Smaller: Shaded-pole type.
5. Thermal Protection: Internal protection to automatically open power supply circuit to motor when winding temperature exceeds a safe value calibrated to temperature rating of motor insulation. Thermal-protection device will automatically reset when motor temperature returns to normal range.

F. Electronically Commutated Motors:

1. Microprocessor-Based Electronic Control Module: Converts 120 V or 240 V single-phase AC power to three-phase DC power to operate the brushless DC motor.
2. Three-phase power motor module with permanent magnet rotor.
3. Circuit board or digital speed controller/LED display.
4. Building Automation System Interface: Via AC voltage signal.

PART 3 - EXECUTION

3.1 INSTALLATION OF SLEEVES - GENERAL

A. Install sleeves for piping passing through penetrations in floors, partitions, roofs, and walls.

B. For sleeves that will have sleeve-seal system installed, select sleeves of size large enough to provide 1-inch annular clear space between piping and concrete slabs and walls.

1. Sleeves are not required for core-drilled holes.

C. Install sleeves in concrete floors, concrete roof slabs, and concrete walls as new slabs and walls are constructed.

1. Permanent sleeves are not required for holes in slabs formed by molded-PE or -PP sleeves.
2. Cut sleeves to length for mounting flush with both surfaces.

a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches above finished floor level.

3. Using grout or silicone sealant, seal space outside of sleeves in floors/slabs/walls without sleeve-seal system. Select to maintain fire resistance of floor/slab/wall.

D. Install sleeves for pipes passing through interior partitions.

1. Cut sleeves to length for mounting flush with both surfaces.
2. Install sleeves that are large enough to provide **1/4-inch** annular clear space between sleeve and pipe or pipe insulation.
3. Seal annular space between sleeve and piping or piping insulation; use joint sealants that joint sealant manufacturer's literature indicates is appropriate for size, depth, and location of joint.

E. Fire-Resistance-Rated Penetrations, Horizontal Assembly Penetrations, and Smoke-Barrier Penetrations: Maintain indicated fire or smoke rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with fire- and smoke-stop materials. Comply with requirements for firestopping and fill materials specified in Section 078413 "Penetration Firestopping."

3.2 INSTALLATION OF SLEEVES WITH WATERSTOP

A. Install sleeve with waterstop as new walls and slabs are constructed.

B. Assemble fitting components of length to be flush with both surfaces of concrete slabs and walls. Position waterstop flange centered across width of concrete slab or wall.

C. Secure nailing flanges to wooden concrete forms.

D. Using grout or silicone sealant, seal space around outside of sleeves.

3.3 INSTALLATION OF STACK-SLEEVE FITTINGS

A. Install stack-sleeve fittings in new slabs as slabs are constructed.

1. Install fittings that are large enough to provide **1/4-inch** annular clear space between sleeve and pipe or pipe insulation.
2. Secure flashing between clamping flanges for pipes penetrating floors with membrane waterproofing. Comply with requirements for flashing specified in Section 076200 "Sheet Metal Flashing and Trim."
3. Install section of cast-iron soil pipe to extend sleeve to **3 inches** above finished floor level.
4. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified.
5. Using silicone sealant, seal space between top hub of stack-sleeve fitting and pipe.

B. Fire-Resistance-Rated Penetrations, Horizontal Assembly Penetrations, and Smoke Barrier Penetrations: Maintain indicated fire or smoke rating of floors at pipe penetrations. Seal pipe penetrations with fire- and smoke-stop materials. Comply with requirements for firestopping specified in Section 078413 "Penetration Firestopping."

3.4 INSTALLATION OF SLEEVE-SEAL SYSTEMS

A. Install sleeve-seal systems in sleeves in exterior concrete walls and slabs-on-grade at service piping entries into building, and passing through exterior walls.

B. Select type, size, and number of sealing elements required for piping material and size and for sleeve ID or hole size. Assemble sleeve-seal system components, and install in annular space between piping and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make a watertight seal.

3.5 FIELD QUALITY CONTROL

A. Sleeves and Sleeve Seals:

1. Perform the following tests and inspections:

a. Leak Test: After allowing for a full cure, test sleeves and sleeve seals for leaks. Repair leaks and retest until no leaks exist.
b. Sleeves and sleeve seals will be considered defective if they do not pass tests and inspections.

2. Prepare test and inspection reports.

B. Escutcheons:

1. Using new materials, replace broken and damaged escutcheons and floor plates.

3.6 SLEEVES APPLICATION

A. Use sleeves and sleeve seals for the following piping-penetration applications:

1. Exterior Concrete Walls above and below Grade:

a. Sleeves with waterstops.

1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.

2. Concrete Slabs-on-Grade:

a. Sleeves with waterstops.

1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.

3. Concrete Slabs above Grade:

a. Sleeves with waterstops or stack-sleeve fittings.

4. Interior Walls and Partitions:

a. Sleeves without waterstops.

END OF SECTION 23 05 00

SECTION 23 05 29 - HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Pipe/tube hangers and supports - copper.
2. Pipe hangers - metal, trapeze type.
3. Pipe hangers - FRP.
4. Strut support system - metal, rod type.
5. Strut support system - rooftop-mounted pipe stand, single base, single pipe, low profile.
6. Strut support system - rooftop-mounted pipe stand, curb-mounted type.
7. Fastener system - powder-actuated fasteners.
8. Fastener system - mechanical expansion anchors.
9. Equipment supports.
10. Equipment stands - outdoor type.

B. Related Requirements:

1. Section 055000 "Metal Fabrications" for structural-steel shapes and plates for trapeze hangers for pipe and equipment supports.
2. Section 230500 "Common Work Results for HVAC" for pipe guides and anchors.
3. Section 233113 "Metal Ducts" and Section 233116 "Nonmetal Ducts" for duct hangers and supports.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: Show fabrication and installation details and include calculations for the following:

1. Trapeze pipe hangers.
2. Metal strut support systems.
3. Rooftop-mounted strut support systems.
4. FRP strut support systems.
5. Pipe stands.
6. Equipment supports.

C. Delegated Design Submittals: For trapeze hangers and strut support systems indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1. Detail fabrication/assembly and design calculations for trapeze hangers.

2. Detail fabrication/assembly and design calculations for each type of strut support system, by the manufacturer's technical representative.

D. Sustainable Design Submittals:

1.3 INFORMATIONAL SUBMITTALS

A. Welding certificates.

1.4 QUALITY ASSURANCE

A. Structural-Steel Welding Qualifications: Qualify procedures and personnel in accordance with AWS D1.1/D1.1M, "Structural Welding Code - Steel."

B. Pipe Welding Qualifications: Qualify procedures and operators in accordance with 2021 ASME Boiler and Pressure Vessel Code, Section IX.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design trapeze hangers , strut support systems, and equipment supports.

2.2 PIPE HANGERS AND SUPPORTS - METAL

A. Pipe/Tube Hangers and Supports - Copper:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

   a. Anvil; an ASC Engineered Solution
   b. Cooper B-line; brand of Eaton, Electrical Sector
   c. FNW; Ferguson Enterprises, Inc.

2. Description: MSS SP-58, Types 1 through 58, copper-plated steel, factory-fabricated components.
3. Hanger Rods: Continuous-thread rod, nuts, and washer made of copper-plated steel.

2.3 Split Ring Hangers

A. Basis-of-Design Product: Subject to compliance with requirements, provide split ring hangers or comparable product by one of the following:

1. FNW; Ferguson Enterprises, Inc.

2.4 PIPE HANGERS - METAL, TRAPEZE TYPE

A. Description: MSS SP-58, Type 59, shop- or field-fabricated pipe-support assembly made from structural carbon-steel shapes with MSS SP-58 carbon-steel hanger rods, nuts, saddles, and U-bolts.

2.5 Standard-Duty Adjustable Clevis Hangers

A. Basis-of-Design Product: Subject to compliance with requirements, provide adjustable clevis hanger or comparable product by one of the following:

1. FNW; Ferguson Enterprises, Inc.

2.6 PIPE HANGERS - FRP

A. Pipe Hangers - FRP, Clevis Type:

1. Description: Similar to MSS SP-58, Type 1, factory-fabricated steel pipe hanger except hanger is made of fiberglass-reinforced plastic resin.
2. Hanger Rods: Continuous-thread stainless steel rod, washer, and nuts made of stainless steel.
3. Flammability: ASTM D635, ASTM E84, and UL 94.

B. Pipe Hangers - FRP, Strap Type:

1. Description: Similar to MSS SP-58, Type 9 or Type 10 steel pipe hanger except hanger is made of fiberglass-reinforced plastic resin.

a. Flammability: ASTM D635, ASTM E84, and UL 94.

2. Hanger Rod and Fittings: Continuous-thread rod, washer, and nuts made of stainless steel.

2.7 Light-Duty Adjustable Clevis Hangers

A. Basis-of-Design Product: Subject to compliance with requirements, provide adjustable clevis hanger or comparable product by one of the following:

1. FNW; Ferguson Enterprises, Inc.

2.8 STRUT SUPPORT SYSTEMS - METAL

A. Strut Support System - Metal, Rod Type:

1. Manufacturers: Subject to compliance with requirements, available

manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. ABB Electrification Installations Products
b. Anvil; an ASC Engineered Solution
c. Atkore Unistrut
d. CADDY; brand of nVent Electrical plc
e. Carpenter & Paterson, Inc
f. Cooper B-line; brand of Eaton, Electrical Sector
g. Empire Industries, Inc.
h. Flex-Strut Inc.
i. G-Strut
j. Haydon Corp.
k. PHD Manufacturing, Inc
l. Rocket Rack; Robroy Industries
m. Wesanco/ZSi-Foster; an Ideal Tridon Group Company

2. Description: Factory-fabricated pipe-support assembly made of steel channels, vertical metal support rods, accessories, fittings, and other components for supporting multiple parallel pipes.
3. Standard: Comply with MFMA-4 factory-fabricated components for field assembly.
4. Struts: Continuous slotted carbon-steel stainless steel, Type 304 stainless steel, Type 316 extruded-aluminum channel with inturned lips or angle.
5. Strut Width: Selected for applicable load criteria.
6. Strut Nuts: Formed or stamped nuts or other devices designed to fit into channel slot and, when tightened, prevent slipping along channel.
7. Hanger Rods: Continuous-thread rod, nuts, and washer made of galvanized steel.
8. Metallic Coating: Pregalvanized G90.
9. Paint Coating: Green epoxy, acrylic, or urethane.
10. Plastic Coating: PVC.

2.9 STRUT SUPPORT SYSTEMS - ROOFTOP MOUNTED

A. Strut Support System - Rooftop-Mounted Pipe Stand, Single Base, Single Pipe, Low Profile:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. G-Strut
b. MIRO Industries Inc.
c. PHP Systems/Design

2. Description:

a. Shop-fabricated assembly made of manufactured corrosion-resistant components to support rooftop-mounted piping.

3. Configuration: Single base with vertical and horizontal members, and pipe support, for roof installation without membrane penetration.
4. Base: Single, vulcanized rubber, molded polypropylene, or polycarbonate.
5. Vertical Members: Two, galvanized-steel, continuous-thread **1/2-inch** rods.
6. Horizontal Member: Adjustable-height, galvanized-steel pipe support channels.
7. Pipe Supports: Roller.
8. Hardware: Galvanized steel.
9. Accessories: Protection pads.
10. Height: 12 inches above roof.

B. Strut Support System - Rooftop-Mounted Pipe Stand, Curb-Mounted Type: Shop- or field-fabricated pipe supports made from structural-steel shapes, continuous-thread rods, and rollers, for mounting on permanent stationary roof curb.

2.10 FASTENER SYSTEMS

A. Fastener System - Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete with pull-out, tension, and shear capacities required for supported loads and building materials where used.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

   a. Hilti, Inc.
   b. ITW Ramset/Red Head; Illinois Tool Works, Inc.
   c. MKT Fastening, LLC

B. Fastener System - Mechanical-Expansion Anchors: Insert-wedge-type anchors for use in hardened portland cement concrete; with pull-out, tension, and shear capacities required for supported loads and building materials where used.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

   a. Cooper B-line; brand of Eaton, Electrical Sector
   b. Empire Industries, Inc.
   c. Hilti, Inc.
   d. ITW Ramset/Red Head; Illinois Tool Works, Inc.
   e. MKT Fastening, LLC

2. Indoor Applications: Zinc-plated or stainless steel.
3. Outdoor Applications: Stainless steel.

2.11 EQUIPMENT SUPPORTS

A. Description: Welded, shop- or field-fabricated equipment support made from structural carbon-steel shapes.

2.12 EQUIPMENT STANDS, OUTDOOR TYPE

A. Equipment Stands, Outdoor Type:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

    a. DiversiTech Corp.
    b. MIRO Industries Inc.
    c. RectorSeal HVAC; a CSW Industrials Company

2. Description: Individual foot supports with elevated adjustable channel cross bars and clamps/fasteners/bolts for ground- or roof-supported outdoor equipment components, without roof membrane penetration, in a prefabricated system that can be modularly assembled on site.
3. Foot Material: Rubber or polypropylene.
4. Rails Material: Hot dip galvanized carbon steel.
5. Wind/Sliding Load Resistance: Up to 100 mph minimum.

2.13 MATERIALS

A. Aluminum: **ASTM B221**.

B. Carbon Steel: ASTM A1011/A1011M.

C. Structural Steel: ASTM A36/A36M, carbon-steel plates, shapes, and bars; galvanized.

D. Stainless Steel: ASTM A240/A240M.

E. Threaded Rods: Continuously threaded. Zinc-plated or galvanized steel for indoor applications and stainless steel for outdoor applications. Mating nuts and washers of similar materials as rods.

F. Grout: ASTM C1107/C1107M, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink and nonmetallic grout; suitable for interior and exterior applications.

1. Properties: Nonstaining, noncorrosive, and nongaseous.
2. Design Mix: **5000 psi**, 28-day compressive strength.

PART 3 - EXECUTION

3.1 APPLICATION

A. Comply with requirements in Section 078413 "Penetration Firestopping" for firestopping materials and installation for penetrations through fire-rated walls, ceilings, and assemblies.

B. Strength of Support Assemblies: Where not indicated, select sizes of components so

strength will be adequate to carry static loads within specified loading limits. Minimum static design load used for strength determination is to include weight of supported components plus 200 lb.

3.2 INSTALLATION OF HANGERS AND SUPPORTS

A. Install hangers and supports to allow controlled thermal and seismic movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.

B. Install lateral bracing with pipe hangers and supports to prevent swaying.

C. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, NPS 2-1/2 and larger and at changes in direction of piping. Coordinate location of concrete inserts before concrete is placed.

D. Load Distribution: Install hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.

E. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and to not exceed maximum pipe deflections allowed by ASME B31.9 for building services piping.

F. Insulated Piping:

1. Attach clamps and spacers to piping.

    a. Piping Operating above Ambient Air Temperature: Clamp may project through insulation.
    b. Piping Operating below Ambient Air Temperature: Use thermal hanger shield insert with clamp sized to match OD of insert.
    c. Do not exceed pipe stress limits allowed by ASME B31.9 for building services piping.

2. Install MSS SP-58, Type 39, protection saddles if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.

    a. Thermal hanger shield inserts may be used as an option. Include steel weight-distribution plate for pipe **NPS 4** and larger if pipe is installed on rollers.

3. Install MSS SP-58, Type 40, protective shields on cold piping with vapor barrier. Shields are to span an arc of 180 degrees.

    a. Thermal hanger shield inserts may be used as an option. Include steel weight-distribution plate for pipe **NPS 4** and larger if pipe is installed on rollers.

4. Shield Dimensions for Pipe: Not less than the following:

    a. NPS 1/4 to NPS 3-1/2 (DN 8 to DN 90): **12 inches** long and **0.048 inch**

thick.
b. NPS 4 (DN 100): **12 inches** long and **0.06 inch** thick.
c. NPS 5 and NPS 6 (DN 125 and DN 150): **18 inches** long and **0.06 inch** thick.
d. NPS 8 to NPS 14 (DN 200 to DN 350): **24 inches** long and **0.075 inch** thick.
e. NPS 16 to NPS 24 (DN 400 to DN 600): **24 inches** long and **0.105 inch** thick.

5. Pipes NPS 8 (DN 200) and Larger: Include wood or reinforced calcium-silicate-insulation inserts of length at least as long as protective shield.

G. Metal Pipe-Hanger Installation: Comply with MSS SP-58. Install hangers, supports, clamps, and attachments as required to properly support piping from the building structure.

H. Metal Trapeze Pipe-Hanger Installation: Comply with MSS SP-58. Arrange for grouping of parallel runs of horizontal piping, and support together on field-fabricated trapeze pipe hangers.

1. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size, or install intermediate supports for smaller diameter pipes as specified for individual pipe hangers.
2. Field fabricate in accordance with ASTM A36/A36M, carbon-steel shapes selected for loads being supported. Weld steel in accordance with AWS D1.1/D1.1M.

I. FRP Pipe-Hanger Installation: Comply with applicable portions of MSS SP-58. Install hangers and attachments as required to properly support piping from building structure.

J. Strut System Installation: Metal, rod type. Arrange for grouping of parallel runs of piping, and support together on field-assembled strut systems. Install in accordance with manufacturer's written installation instructions.

K. Thermal Hanger Shield Installation: Install in pipe hanger or shield for insulated piping.

L. Fastener System Installation:

1. Install powder-actuated fasteners for use in lightweight concrete or concrete slabs less than **4 inches** thick after concrete is placed and cured. Use installers that are trained and certified by power tool manufacturer.
2. Install mechanical-expansion anchors after concrete is placed and completely cured.
3. Install fasteners in accordance with manufacturer's written instructions.
4. Install lag screw wood fasteners in accordance with manufacturer's written instructions.

M. Pipe Stand Installation:

1. Pipe Stand Types except Curb-Mounted Type: Assemble components and mount on smooth roof surface. Do not penetrate roof membrane.

2. Curb-Mounted-Type Pipe Stands: Assemble components or fabricate pipe stand and mount on permanent, stationary roof curb. See Section 077200 "Roof Accessories" for curbs.

N. Install hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.

O. Equipment Support Installation:

1. Fabricate from welded-structural-steel shapes.
2. Fabricate structural-steel stands to suspend equipment from structure overhead or to support equipment above floor.
3. Grouting: Place grout under supports for floor-mounted equipment, and make bearing surface smooth.
4. Provide lateral bracing, to prevent swaying.

3.3 METAL FABRICATIONS

A. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers and equipment supports.

B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded.

C. Field Welding: Comply with AWS D1.1/D1.1M procedures for shielded, metal arc welding; appearance and quality of welds; methods used in correcting welding work; and with the following:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove welding flux immediately.
4. Finish welds at exposed connections so no roughness shows after finishing and so contours of welded surfaces match adjacent contours.

3.4 ADJUSTING

A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.

B. Trim excess length of continuous-thread hanger and support rods to 1-1/2 inches.

3.5 PAINTING

A. Touchup:

1. Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-

painted surfaces.

a. Apply paint by brush or spray to provide a minimum dry film thickness of **2.0 mils**.

2. Comply with requirements in Section 099113 "Exterior Painting" for cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal.
3. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A780/A780M.

3.6 HANGER AND SUPPORT SCHEDULE

A. Specific hanger and support requirements are in Sections specifying piping systems and equipment.

B. Comply with MSS SP-58 for pipe-hanger selections and applications that are not specified in piping system Sections.

C. Use hangers and supports with galvanized metallic coatings for piping and equipment that will not have field-applied finish.

D. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.

E. Use carbon-steel pipe hangers and supports metal trapeze pipe hangers and and attachments for general service applications.

F. Use stainless steel pipe hangers and stainless steel or corrosion-resistant attachments for hostile environment applications.

G. Use copper-plated pipe hangers and copper or stainless steel attachments for copper piping and tubing.

H. Use padded hangers for piping that is subject to scratching.

I. Use thermal hanger shield inserts for insulated piping and tubing.

J. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of noninsulated or insulated, stationary pipes **NPS 1/2 to NPS 30**.
2. Yoke-Type Pipe Clamps (MSS Type 2): For suspension of up to **1050 deg F**, pipes **NPS 4 to NPS 24**, requiring up to **4 inches** of insulation.
3. Carbon- or Alloy-Steel, Double-Bolt Pipe Clamps (MSS Type 3): For suspension of pipes **NPS 3/4 to NPS 36**, requiring clamp flexibility and up to **4 inches** of insulation.
4. Steel Pipe Clamps (MSS Type 4): For suspension of cold and hot pipes **NPS 1/2 to NPS 24** if little or no insulation is required.

5. Pipe Hangers (MSS Type 5): For suspension of pipes **NPS 1/2 to NPS 4**, to allow off-center closure for hanger installation before pipe erection.
6. Adjustable, Swivel Split- or Solid-Ring Hangers (MSS Type 6): For suspension of noninsulated, stationary pipes **NPS 3/4 to NPS 8**.
7. Adjustable, Steel Band Hangers (MSS Type 7): For suspension of noninsulated, stationary pipes **NPS 1/2 to NPS 8**.
8. Adjustable Band Hangers (MSS Type 9): For suspension of noninsulated, stationary pipes **NPS 1/2 to NPS 8**.
9. Adjustable, Swivel-Ring Band Hangers (MSS Type 10): For suspension of noninsulated, stationary pipes **NPS 1/2 to NPS 8**.
10. Split Pipe Ring with or without Turnbuckle Hangers (MSS Type 11): For suspension of noninsulated, stationary pipes **NPS 3/8 to NPS 8**.
11. Extension Hinged or Two-Bolt Split Pipe Clamps (MSS Type 12): For suspension of noninsulated, stationary pipes **NPS 3/8 to NPS 3**.
12. U-Bolts (MSS Type 24): For support of heavy pipes **NPS 1/2 to NPS 30**.
13. Clips (MSS Type 26): For support of insulated pipes not subject to expansion or contraction.
14. Pipe Saddle Supports (MSS Type 36): For support of pipes **NPS 4 to NPS 36**, with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate.
15. Pipe Stanchion Saddles (MSS Type 37): For support of pipes **NPS 4 to NPS 36**, with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate, and with U-bolt to retain pipe.
16. Adjustable Pipe Saddle Supports (MSS Type 38): For stanchion-type support for pipes **NPS 2-1/2 to NPS 36** if vertical adjustment is required, with steel-pipe base stanchion support and cast-iron floor flange.
17. Single-Pipe Rolls (MSS Type 41): For suspension of pipes **NPS 1 to NPS 30**, from two rods if longitudinal movement caused by expansion and contraction might occur.
18. Adjustable Roller Hangers (MSS Type 43): For suspension of pipes **NPS 2-1/2 to NPS 24**, from single rod if horizontal movement caused by expansion and contraction might occur.
19. Complete Pipe Rolls (MSS Type 44): For support of pipes **NPS 2 to NPS 42** if longitudinal movement caused by expansion and contraction might occur but vertical adjustment is unnecessary.
20. Pipe Roll and Plate Units (MSS Type 45): For support of pipes **NPS 2 to NPS 24** if small horizontal movement caused by expansion and contraction might occur and vertical adjustment is unnecessary.
21. Adjustable Pipe Roll and Base Units (MSS Type 46): For support of pipes **NPS 2 to NPS 30** if vertical and lateral adjustment during installation might be required in addition to expansion and contraction.

K. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers **NPS 3/4 to NPS 24**.
2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers **NPS 3/4 to NPS 24** if longer ends are required for riser clamps.

L. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping

system Sections, install the following types:

1. Steel Turnbuckles (MSS Type 13): For adjustment up to **6 inches** for heavy loads.
2. Steel Clevises (MSS Type 14): For **120 to 450 deg F** piping installations.
3. Swivel Turnbuckles (MSS Type 15): For use with MSS Type 11, split pipe rings.
4. Malleable-Iron Sockets (MSS Type 16): For attaching hanger rods to various types of building attachments.
5. Steel Weldless Eye Nuts (MSS Type 17): For **120 to 450 deg F** piping installations.

M. Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Steel or Malleable Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete ceiling.
2. Top-Beam C-Clamps (MSS Type 19): For use under roof installations with bar-joist construction, to attach to top flange of structural shape.
3. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles.
4. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.
5. Welded Beam Attachments (MSS Type 22): For attaching to bottom of beams if loads are considerable and rod sizes are large.
6. C-Clamps (MSS Type 23): For structural shapes.
7. Top-Beam Clamps (MSS Type 25): For top of beams if hanger rod is required tangent to flange edge.
8. Side-Beam Clamps (MSS Type 27): For bottom of steel I-beams.
9. Steel-Beam Clamps with Eye Nuts (MSS Type 28): For attaching to bottom of steel I-beams for heavy loads.
10. Linked-Steel Clamps with Eye Nuts (MSS Type 29): For attaching to bottom of steel I-beams for heavy loads, with link extensions.
11. Malleable-Beam Clamps with Extension Pieces (MSS Type 30): For attaching to structural steel.
12. Welded-Steel Brackets: For support of pipes from below or for suspending from above by using clip and rod. Use one of the following for indicated loads:

    a. Light (MSS Type 31): **750 lb**.
    b. Medium (MSS Type 32): **1500 lb**.
    c. Heavy (MSS Type 33): **3000 lb**.

13. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.
14. Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is required.
15. Horizontal Travelers (MSS Type 58): For supporting piping systems subject to linear horizontal movement where headroom is limited.

N. Saddles and Shields: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Steel-Pipe-Covering Protection Saddles (MSS Type 39): To fill interior voids with

insulation that matches adjoining insulation.

2. Protection Shields (MSS Type 40): Of length recommended in writing by manufacturer to prevent crushing insulation.
3. Thermal Hanger Shield Inserts: For supporting insulated pipe.

O. Spring Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Restraint-Control Devices (MSS Type 47): Where indicated to control piping movement.
2. Spring Cushions (MSS Type 48): For light loads if vertical movement does not exceed **1-1/4 inches**.
3. Spring-Cushion Roll Hangers (MSS Type 49): For equipping Type 41, roll hanger with springs.
4. Spring Sway Braces (MSS Type 50): To retard sway, shock, vibration, or thermal expansion in piping systems.
5. Variable-Spring Hangers (MSS Type 51): Preset to indicated load and limit variability factor to 25 percent to allow expansion and contraction of piping system from hanger.
6. Variable-Spring Base Supports (MSS Type 52): Preset to indicated load and limit variability factor to 25 percent to allow expansion and contraction of piping system from base support.
7. Variable-Spring Trapeze Hangers (MSS Type 53): Preset to indicated load and limit variability factor to 25 percent to allow expansion and contraction of piping system from trapeze support.
8. Constant Supports: For critical piping stress and if necessary to avoid transfer of stress from one support to another support, critical terminal, or connected equipment. Include auxiliary stops for erection, hydrostatic test, and load-adjustment capability. These supports include the following types:

    a. Horizontal (MSS Type 54): Mounted horizontally.
    b. Vertical (MSS Type 55): Mounted vertically.
    c. Trapeze (MSS Type 56): Two vertical-type supports and one trapeze member.

P. Comply with MSS SP-58 for trapeze pipe-hanger selections and applications that are not specified in piping system Sections.

Q. Use powder-actuated fasteners or mechanical-expansion anchors instead of building attachments where required in concrete construction.

END OF SECTION 23 05 29

SECTION 23 05 48.13 - VIBRATION CONTROLS FOR HVAC

PART 1 - GENERAL

1.1 SUMMARY

A. Related Requirements:

1. Section 210548.13 "Vibration Controls for Fire-Suppression Piping and Equipment" for devices for fire-suppression equipment and systems.
2. Section 220548.13 "Vibration Controls for Plumbing Piping and Equipment" for devices for plumbing equipment and systems.

1.2 DEFINITIONS

A. IBC: International Building Code.

B. OSHPD: Office of Statewide Health Planning and Development (for the State of California owned and regulated medical facilities).

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include rated load, rated deflection, and overload capacity for each vibration isolation device.
2. Include load rating for each wind-force-restraint fitting and assembly.
3. Illustrate and indicate style, material, strength, fastening provision, and finish for each type and size of vibration isolation device and wind-force-restraint component.
4. Annotate to indicate application of each product submitted and compliance with requirements.
5. Interlocking Snubbers: Include ratings for horizontal, vertical, and combined loads.

B. Shop Drawings:

1. Detail fabrication and assembly of equipment bases.
2. Vibration Isolation Base Details: Detail fabrication including anchorages and attachments to structure and to supported equipment. Include adjustable motor bases, rails, and frames for equipment mounting.

C. Delegated-Design Submittal:

1. For each wind-load protection device that is required by this Section or is indicated on Drawings, submit the following:

a. Vibration Isolator and Wind-Load-Restraint Selection: Select vibration isolators, wind-load restraints, and vibration isolation bases complying with performance requirements, design criteria, and analysis data.
b. Riser Supports: Include riser diagrams and calculations showing anticipated expansion and contraction at each support point, initial and final loads on building structure, and spring deflection changes. Include certification by professional engineer that riser system was examined for excessive stress and that none exists.
c. Concrete Anchors and Inserts: Include calculations showing anticipated wind loads.
d. Wind-Load Design Calculations: Submit all static and dynamic loading calculations prepared under "Wind-Load Design Calculations" Paragraph in "Performance Requirements" Article.
e. Qualified Professional Engineer: All designated-design submittals for wind-restraint calculations are to be signed and sealed by qualified professional engineer responsible for their preparation.

2. Wind-Restraint Detail Drawing:

a. Design Analysis: To support selection and arrangement of wind restraints. Include calculations of combined tensile and shear loads.
b. Details: Indicate fabrication and arrangement. Detail attachments of restraints to restrained items and to the structure. Show attachment locations, methods, and spacings. Identify components, list their strengths, and indicate directions and values of forces transmitted to the structure during wind events. Indicate association with vibration isolation devices.
c. Coordinate vibration isolation details with wind-restraint details required for equipment mounted outdoors. Comply also with requirements in other Sections for equipment mounted outdoors.

3. All delegated-design submittals for wind-restraint detail Drawings are to be signed and sealed by qualified professional engineer responsible for their preparation.
4. Product Listing, Preapproval, and Evaluation Documentation: Byan agency acceptable to authorities having jurisdiction, showing maximum ratings of restraint items and basis for approval (tests or calculations).
5. Design Calculations for Vibration Isolation Devices: Calculate static and dynamic loading due to equipment weight and operating forces required to select proper vibration isolators, and to design vibration isolation bases.
6. Riser Supports: Include riser diagrams and calculations showing anticipated expansion and contraction at each support point, initial and final loads on building structure, and spring deflection changes. Include certification that riser system was examined for excessive stress and that none exists.

1.4 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Show coordination of vibration isolation device installation for HVAC piping and equipment with other systems and equipment in the vicinity, including other supports and restraints.

B. Qualification Data: For testing agency.

C. Welding certificates.

D. Air-Spring Mounting System Performance Certification: Include natural frequency, load, and damping test data.

E. Field quality-control reports.

F. Wind-Force Performance Certification: Provide special certification for HVAC components subject to high wind exposure and impact damage and designated on Drawings or in the Specifications to require wind-force performance certification.

1. Provide equipment manufacturer's written certification for each designated HVAC device, stating that it will remain in place and operable following the design wind event and comply with all requirements of authorities having jurisdiction.
2. Provide manufacturer's written certification for each designated louver, damper, or similar device, stating that it will remain in place and protect opening from penetration of windborne debris and comply with all requirements of authorities having jurisdiction.
3. Certification must be based on ICC-ES or similar nationally recognized testing standard procedures acceptable to authorities having jurisdiction.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For air-spring mounts and restrained-air-spring mounts to include in operation and maintenance manuals.

1.6 QUALITY ASSURANCE

A. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct testing indicated, be an NRTL as defined by OSHA in 29 CFR 1910.7 and be acceptable to authorities having jurisdiction.

B. Welding Qualifications: Qualify procedures and personnel in accordance with AWS D1.1/D1.1M, "Structural Welding Code - Steel."

C. Wind-Load-Restraint Device Load Ratings: Devices to be tested and rated in accordance with applicable code requirements and authorities having jurisdiction. Devices to be listed by a nationally recognized third party that requires periodic follow-up inspections and has a listing directory available to the public. Provide third-party listing by one or more of the following: an agency acceptable to authorities having jurisdiction.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design system.

B. Wind-Load Design Calculations:

1. Perform calculations to obtain force information necessary to properly select wind-load-restraint devices, fasteners, and anchorage. Perform calculations using methods acceptable to applicable code authorities and as presented in a method required by authorities having jurisdiction.

a. Factors indicated below that are specific to individual pieces of equipment must be obtained by Contractor and must be included in individual component submittal packages.
b. Coordinate design wind-load calculations with vibration isolation requirements. Comply with requirements in other Sections in addition to those in this Section for equipment mounted outdoors.

C. Fire/Smoke Resistance: All components that are not constructed of ferrous metals must have a maximum flame-spread index of 25 and maximum smoke-developed index of 50 when tested by an NRTL in accordance with ASTM E84 or UL 723, and be so labeled.

D. Component Supports:

1. Load ratings, features, and applications of all reinforcement components must be based on testing standards of a nationally recognized testing agency.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and equipment to receive vibration isolation and wind-load control devices for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine roughing-in of reinforcement and cast-in-place anchors to verify actual locations before installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 APPLICATIONS

A. Multiple Pipe Supports: Secure pipes to trapeze member with clamps approved for application byan agency acceptable to authorities having jurisdiction.

B. Hanger-Rod Stiffeners: Install hanger-rod stiffeners where indicated or scheduled on Drawings to receive them and where required to prevent buckling of hanger rods due to wind-load forces.

C. Strength of Support Assemblies: Where not indicated, select sizes of components so strength is adequate to carry static and wind force loads within specified loading limits.

3.3 INSTALLATION OF VIBRATION AND WIND-LOAD CONTROL DEVICES

A. Provide vibration and wind-load control devices for systems and equipment where indicated in Equipment Schedules or Vibration-Control Device Schedules on Drawings, where Specifications indicate they are to be installed on specific equipment and systems, and where required by applicable codes.

B. Coordinate location of embedded connection hardware with supported equipment attachment and mounting points and with requirements for concrete reinforcement and formwork specified in Section 033000 "Cast-in-Place Concrete."

C. Installation of vibration isolators and wind-load restraints must not cause any change of position of equipment, piping, or ductwork resulting in stresses or misalignment.

D. Comply with requirements in Section 077200 "Roof Accessories" for installation of roof curbs, equipment supports, and roof penetrations.

E. Equipment Restraints:

1. Install snubbers on HVAC equipment mounted on vibration isolators. Locate snubbers as close as possible to vibration isolators and bolt to equipment base and supporting structure.
2. Install resilient bolt isolation washers on equipment anchor bolts where clearance between anchor and adjacent surface exceeds **0.125 inch**.
3. Install wind-load-restraint devices using methods approved byan agency acceptable to authorities having jurisdiction that provides required submittals for component.

F. Piping Restraints:

1. Comply with requirements in MSS SP-127.
2. Space lateral supports a maximum of 40 feet o.c., and longitudinal supports a maximum of 80 feet o.c.
3. Brace a change of direction longer than **12 feet**.

G. Install wind-load-restraint cables so they do not bend across edges of adjacent equipment or building structure.

H. Install wind-load-restraint devices using methods approved byan agency acceptable to authorities having jurisdiction that provides required submittals for component.

I. Install bushing assemblies for anchor bolts for floor-mounted equipment, arranged to provide resilient media between anchor bolt and mounting hole in concrete base.

J. Install bushing assemblies for mounting bolts for wall-mounted equipment, arranged to provide resilient media where equipment or equipment-mounting channels are attached to wall.

K. Attachment to Structure: If specific attachment is not indicated, anchor bracing to structure at flanges of beams, at upper truss chords of bar joists, or at concrete members.

L. Post-Installed Concrete Anchors:

1. Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Do not damage existing reinforcing or embedded items during coring or drilling. Notify structural engineer if reinforcing steel or other embedded items are encountered during drilling. Locate and avoid prestressed tendons, electrical and telecommunications conduit, and gas lines.
2. Do not drill holes in concrete or masonry until concrete, mortar, or grout has achieved full design strength.
3. Wedge-Type Anchor Bolts: Protect threads from damage during anchor installation. Heavy-duty sleeve anchors shall be installed with sleeve fully engaged in the structural element to which anchor is to be fastened.
4. Adhesive-Type Anchor Bolts: Clean holes to remove loose material and drilling dust prior to installation of adhesive. Place adhesive in holes proceeding from the bottom of the hole and progressing toward the surface in such a manner as to avoid introduction of air pockets in the adhesive.
5. Set anchors to manufacturer's recommended torque, using a torque wrench.
6. Install zinc-coated steel anchors for interior and stainless steel anchors for exterior applications.

3.4 ACCOMMODATION OF DIFFERENTIAL MOTION

A. Provide flexible connections in piping systems where they cross structural joints and other point where differential movement may occur. Provide adequate flexibility to accommodate differential movement as determined in accordance with ASCE/SEI 7. Comply with requirements in Section 232113 "Hydronic Piping" and Section 232116 "Hydronic Piping Specialties" for piping flexible connections.

3.5 ADJUSTING

A. Adjust isolators after system is at operating weight.

B. Adjust limit stops on restrained-spring isolators to mount equipment at normal operating height. After equipment installation is complete, adjust limit stops so they are out of contact during normal operation.

3.6 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

C. Perform tests and inspections.

D. Tests and Inspections:

1. Provide evidence of recent calibration of test equipment by a testing agency acceptable to authorities having jurisdiction.
2. Schedule test with Owner, through Architect, before connecting anchorage device to restrained component (unless postconnection testing has been approved), and with at least seven days' advance notice.
3. Obtain Architect's approval before transmitting test loads to structure. Provide temporary load-spreading members.
4. Test at least four of each type and size of installed anchors and fasteners selected by Architect.
5. Test to 90 percent of rated proof load of device.
6. Measure isolator restraint clearance.
7. Measure isolator deflection.
8. Verify snubber minimum clearances.
9. Test and adjust restrained-air-spring isolator controls and safeties.

E. Remove and replace malfunctioning units and retest as specified above.

F. Prepare test and inspection reports.

END OF SECTION 23 05 48.13

SECTION 23 05 53 - IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Warning signs and labels.
2. Pipe labels.
3. Duct labels.
4. Stencils.
5. Valve tags.
6. Warning tags.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Samples: For color, letter style, and graphic representation required for each identification material and device.

C. Equipment-Label Schedule: Include a listing of all equipment to be labeled with the proposed content for each label.

D. Valve-numbering scheme.

E. Valve Schedules: Provide for each piping system. Include in operation and maintenance manuals.

PART 2 - PRODUCTS

2.1 WARNING SIGNS AND LABELS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Brady Corporation
2. Carlton Industries, LP
3. Champion America
4. Craftmark Pipe Markers
5. emedco
6. LEM Products Inc.
7. Marking Services Inc.
8. National Marker Company

9. Pipemarker.com; Brimar Industries, Inc.
10. Seton Identification Products; a Brady Corporation company
11. Stranco, Inc.

B. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch thick, with predrilled holes for attachment hardware.

C. Letter and Background Color: As indicated for specific application under Part 3.

D. Maximum Temperature: Able to withstand temperatures of up to **160 deg F**.

E. Minimum Label Size: Length and width vary for required label content, but not less than **2-1/2 by 3/4 inch**.

F. Minimum Letter Size: **1/4 inch** for name of units if viewing distance is less than **24 inches**, **1/2 inch** for viewing distances of up to **72 inches**, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.

G. Fasteners: Stainless steel rivets or self-taping screws.

H. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

I. Arc-Flash Warning Signs: Provide arc-flash warning signs in locations and with content in accordance with requirements of OSHA and NFPA70E and other applicable codes and standards.

J. Label Content: Include caution and warning information plus emergency notification instructions.

2.2 PIPE LABELS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Actioncraft Products, Inc.; a division of Industrial Test Equipment Co., Inc.
2. Brady Corporation
3. Carlton Industries, LP
4. Champion America
5. Craftmark Pipe Markers
6. emedco
7. Kolbi Pipe Marker Co.
8. LEM Products Inc.
9. Marking Services Inc.
10. Pipemarker.com; Brimar Industries, Inc.
11. Seton Identification Products; a Brady Corporation company

B. General Requirements for Manufactured Pipe Labels: Preprinted, color coded, with lettering indicating service and showing flow direction in accordance with ASME A13.1.

C. Letter and Background Color: As indicated for specific application under Part 3.

D. Pretensioned Pipe Labels: Precoiled, semirigid plastic formed to cover full circumference of pipe and to attach to pipe without fasteners or adhesive.

E. Self-Adhesive Pipe Labels: Printed plastic with contact-type, permanent-adhesive backing.

F. Pipe Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings. Also include:

1. Pipe size.
2. Flow-Direction Arrows: Include flow-direction arrows on main distribution piping. Arrows may be either integral with label or applied separately.
3. Lettering Size: Size letters in accordance with ASME A13.1 for piping.

2.3 DUCT LABELS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Brady Corporation
2. Carlton Industries, LP
3. Champion America
4. Craftmark Pipe Markers
5. emedco
6. Kolbi Pipe Marker Co.
7. LEM Products Inc.
8. Marking Services Inc.
9. Pipemarker.com; Brimar Industries, Inc.
10. Seton Identification Products; a Brady Corporation company

B. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch thick, and having predrilled holes for attachment hardware.

C. Letter and Background Color: As indicated for specific application under Part 3.

D. Maximum Temperature: Able to withstand temperatures up to **160 deg F**.

E. Minimum Label Size: Length and width vary for required label content, but not less than **2-1/2 by 3/4 inch**.

F. Minimum Letter Size: **1/4 inch** for name of units if viewing distance is less than **24 inches**, **1/2 inch** for viewing distances of up to **72 inches**, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.

G. Fasteners: Stainless steel rivets or self-tapping screws.

H. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

I. Duct Label Contents: Include identification of duct service using same designations or abbreviations as used on Drawings. Also include the following:

1. Duct size.
2. Flow-Direction Arrows: Include flow-direction arrows on main distribution ducts. Arrows may be either integral with label or may be applied separately.
3. Lettering Size: Size letters in accordance with ASME A13.1 for piping.

2.4 STENCILS

A. Stencils for Ducts:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

   a. Craftmark Pipe Markers
   b. Kolbi Pipe Marker Co.
   c. Marking Services Inc.
   d. Pipemarker.com; Brimar Industries, Inc.

2. Lettering Size: Minimum letter height of **1-1/4 inches** for viewing distances of up to **15 ft.** and proportionately larger lettering for greater viewing distances.
3. Stencil Material: Brass.
4. Stencil Paint: Exterior, gloss, acrylic enamel. Paint may be in pressurized spray-can form.
5. Identification Paint: Exterior, acrylic enamel. Paint may be in pressurized spray-can form.
6. Letter and Background Color: Color as indicated for specific application under Part 3.

B. Stencils for Access Panels and Door Labels, Equipment Labels, and Similar Operational Instructions:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

   a. Craftmark Pipe Markers
   b. Kolbi Pipe Marker Co.
   c. Marking Services Inc.
   d. Pipemarker.com; Brimar Industries, Inc.

2. Lettering Size: Minimum letter height of **1/2 inch** for viewing distances of up to **72 inches** and proportionately larger lettering for greater viewing distances.
3. Stencil Material: Brass.
4. Stencil Paint: Exterior, gloss, acrylic enamel. Paint may be in pressurized spray-can form.

5. Identification Paint: Exterior, acrylic enamel. Paint may be in pressurized spray-can form.
6. Letter and Background Color: As indicated for specific application under Part 3.

2.5 VALVE TAGS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Actioncraft Products, Inc.; a division of Industrial Test Equipment Co., Inc.
2. Brady Corporation
3. Carlton Industries, LP
4. Champion America
5. Craftmark Pipe Markers
6. emedco
7. Kolbi Pipe Marker Co.
8. LEM Products Inc.
9. Marking Services Inc.
10. Pipemarker.com; Brimar Industries, Inc.
11. Seton Identification Products; a Brady Corporation company

B. Description: Stamped or engraved with **1/4-inch** letters for piping system abbreviation and **1/2-inch** numbers.

1. Tag Material: Brass, 0.04-inch minimum thickness, with predrilled or stamped holes for attachment hardware.
2. Fasteners: Brass link chain or beaded chain or S-hook.

C. Letter and Background Color: As indicated for specific application under Part 3.

D. Valve Schedules: For each piping system, on **8-1/2-by-11-inch** bond paper. Tabulate valve number, piping system, system abbreviation (as shown on valve tag), location of valve (room or space), normal-operating position (open, closed, or modulating), and variations for identification. Mark valves for emergency shutoff and similar special uses.

1. Include valve-tag schedule in operation and maintenance data.

2.6 WARNING TAGS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Brady Corporation
2. Champion America
3. Craftmark Pipe Markers
4. emedco
5. Kolbi Pipe Marker Co.

6. LEM Products Inc.
7. Marking Services Inc.
8. Pipemarker.com; Brimar Industries, Inc.
9. Seton Identification Products; a Brady Corporation company

B. Description: Preprinted or partially preprinted accident-prevention tags of plasticized card stock with matte finish suitable for writing.

1. Size: 3 by 5-1/4 inches minimum.
2. Fasteners: Brass grommet and wire.
3. Nomenclature: Large-size primary caption, such as "DANGER," "CAUTION," or "DO NOT OPERATE."
4. Letter and Background Color: As indicated for specific application under Part 3.

PART 3 - EXECUTION

3.1 PREPARATION

A. Clean piping and equipment surfaces of incompatible primers, paints, and encapsulants, as well as dirt, oil, grease, release agents, and other substances that could impair bond of identification devices.

3.2 INSTALLATION, GENERAL REQUIREMENTS

A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.

B. Coordinate installation of identifying devices with locations of access panels and doors.

C. Install identifying devices before installing acoustical ceilings and similar concealment.

D. Locate identifying devices so that they are readily visible from the point of normal approach.

3.3 INSTALLATION OF PIPE LABELS

A. Piping Color Coding: Painting of piping is specified in Section 099600 "High-Performance Coatings."

B. Install pipe labels showing service and flow direction with permanent adhesive on pipes.

C. Stenciled Pipe Label Option: Stenciled labels showing service and flow direction may be provided instead of manufactured pipe labels, at Installer's option. Install stenciled pipe labels, complying with ASME A13.1, with painted, color-coded bands or rectangles on each piping system.

1. Identification Paint: Use for contrasting background.

2. Stencil Paint: Use for pipe marking.

D. Pipe-Label Locations: Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior exposed locations as follows:

1. Within **3 ft.** of each valve and control device.
2. At access doors, manholes, and similar access points that permit view of concealed piping.
3. Within **3 ft.** of equipment items and other points of origination and termination.
4. Spaced at maximum intervals of 25 ft. along each run. Reduce intervals to 10 ft. in areas of congested piping, ductwork, and equipment.

E. Do not apply plastic pipe labels or plastic tapes directly to bare pipes conveying fluids at temperatures of **125 deg F** or higher. Where these pipes are to remain uninsulated, use a short section of insulation or use stenciled labels.

F. Flow-Direction Arrows: Use arrows to indicate direction of flow in pipes, including pipes where flow is allowed in both directions.

G. Pipe-Label Color Schedule:

1. Refrigerant Piping: White letters on an ANSI Z535.1 safety-blue background.
2. Potable and Other Water: White letters on an ANSI Z535.1 safety-green background.

3.4 INSTALLATION OF DUCT LABELS

A. Install plastic-laminated duct labels showing service and flow direction with permanent adhesive on air ducts.

1. Provide labels in the following color codes:

a. For air supply ducts: White letters on blue background.
b. For air return ducts: White letters on blue background.
c. For exhaust-, outside-, relief-, return-, and mixed-air ducts: White letters on blue background.
d. Insert additional systems and colors as needed.

B. Stenciled Duct-Label Option: Stenciled labels showing service and flow direction may be provided instead of plastic-laminated duct labels, at Installer's option.

1. For all air ducts: Black letters on white background.

C. Locate label near each point where ducts enter into and exit from concealed spaces and at maximum intervals of 20 ft. where exposed or are concealed by removable ceiling system.

D. Stenciled Access Panels and Door Labels, Equipment Labels, and Similar Operational Instructions:

1. Black letters on White background.

3.5 INSTALLATION OF VALVE TAGS

A. Install tags on valves and control devices in piping systems, except check valves, valves within factory-fabricated equipment units, shutoff valves, and HVAC terminal devices and similar roughing-in connections of end-use fixtures and units. List tagged valves in a valve schedule in the operating and maintenance manual.

B. Valve-Tag Application Schedule: Tag valves according to size, shape, and color scheme and with captions similar to those indicated in "Valve-Tag Size and Shape" Subparagraph below.

1. Valve-Tag Size and Shape:
2. Valve-Tag Colors:

a. For each piping system, use the same lettering and background coloring system on valve tags as used for the Pipe Label Schedule text and background.

3.6 INSTALLATION OF WARNING TAGS

A. Warning Tag Color: Black letters on an ANSI Z535.1 safety-yellow background.

B. Attach warning tags, with proper message, to equipment and other items where indicated on Drawings.

END OF SECTION 23 05 53

SECTION 23 05 93 - TESTING, ADJUSTING, AND BALANCING FOR HVAC

PART 1 - GENERAL

1.1 SUMMARY

A. The Work of this Section Includes:

1. TAB of Air Systems:

a. Constant-volume air systems.
b. Dual-duct systems.

2. TAB of equipment.
3. Procedures for exhaust hoods.
4. Duct-leakage tests verification.
5. Pipe-leakage tests verification.
6. HVAC-control system verification.

B. Related Requirements:

1. Section 220593 "Testing, Adjusting, and Balancing for Plumbing" for TAB of plumbing systems and equipment.

C. TAB Conference: Conduct a TAB conference at Project site after approval of the TAB strategies and procedures plan, to develop a mutual understanding of the details. Provide a minimum of 14 days' advance notice of scheduled meeting time and location.

1. Minimum Agenda Items:

1.2 QUALITY ASSURANCE

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

A. Subject to compliance with requirements, available TAB specialist firm that may be engaged include, but are not limited to, the following:

END OF SECTION 23 05 93

SECTION 23 07 13 - DUCT INSULATION

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes insulating the following duct services:

1. Indoor, concealed supply and outdoor air.
2. Indoor, exposed supply and outdoor air.
3. Indoor, concealed return located in unconditioned space.
4. Indoor, exposed return located in unconditioned space.
5. Indoor, concealed, Type I, commercial, kitchen hood exhaust.
6. Indoor, exposed, Type I, commercial, kitchen hood exhaust.
7. Indoor, concealed oven and warewash exhaust.
8. Indoor, exposed oven and warewash exhaust.
9. Indoor, concealed exhaust between isolation damper and penetration of building exterior.
10. Indoor, exposed exhaust between isolation damper and penetration of building exterior.
11. Outdoor, concealed supply and return.
12. Outdoor, exposed supply and return.

B. Related Requirements:

1. Section 230716 "HVAC Equipment Insulation."
2. Section 230719 "HVAC Piping Insulation."
3. Section 233113 "Metal Ducts" for duct liners.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include thermal conductivity, water-vapor permeance thickness, and jackets (both factory- and field-applied if any).

B. Sustainable Design Submittals:

C. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.

1. Detail application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.
2. Detail insulation application at elbows, fittings, dampers, specialties and flanges for each type of insulation.
3. Detail application of field-applied jackets.
4. Detail application at linkages of control devices.

D. Samples: For each type of insulation and jacket indicated. Identify each Sample, describing product and intended use. Sample sizes are as follows:

1. Sheet Form Insulation Materials: **12 inches** square.
2. Sheet Jacket Materials: **12 inches** square.
3. Manufacturer's Color Charts: For products where color is specified, show the full range of colors available for each type of finish material.

1.3 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified Installer.

B. Material Test Reports: From a qualified testing agency acceptable to authorities having jurisdiction indicating, interpreting, and certifying test results for compliance of insulation materials, sealers, attachments, cements, and jackets, with requirements indicated. Include dates of tests and test methods employed.

C. Field quality-control reports.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or craft training program .

B. Mockups: Before installing insulation, build mockups for each type of insulation and finish listed below to demonstrate quality of insulation application and finishes. Build mockups in the location indicated or, if not indicated, as directed by Architect. Use materials indicated for the completed Work.

1. Ductwork Mockups:

    a. One **10-foot** section each of rectangular and round straight duct.
    b. One each of a 90-degree mitered round and rectangular elbow, and one each of a 90-degree radius round and rectangular elbow.
    c. One rectangular branch takeoff and one round branch takeoff from a rectangular duct. One round tee fitting.
    d. One rectangular and round transition fitting.
    e. Four support hangers for round and rectangular ductwork.
    f. Each type of damper and specialty.

2. For each mockup, fabricate cutaway sections to allow observation of application details for insulation materials, adhesives, mastics, attachments, and jackets.
3. Notify Architect seven days in advance of dates and times when mockups will be constructed.
4. Obtain Architect's approval of mockups before starting insulation application.
5. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
6. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.
7. Demolish and remove mockups when directed.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Packaging: Insulation material containers are to be marked with the manufacturer's name, appropriate ASTM standard designation, type and grade, and maximum use temperature.

1.6 COORDINATION

A. Coordinate sizes and locations of supports, hangers, and insulation shields specified in Section 230529 "Hangers and Supports for HVAC Piping and Equipment."

B. Coordinate clearance requirements with duct Installer for duct insulation application. Before preparing ductwork Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.

C. Coordinate installation and testing of heat tracing.

1.7 SCHEDULING

A. Schedule insulation application after pressure testing systems and, where required, after installing and testing heat tracing. Insulation application may begin on segments that have satisfactory test results.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products in accordance with ASTM E84, by a testing agency acceptable to authorities having jurisdiction. Factory label insulation, jacket materials, adhesive, mastic, tapes, and cement material containers with appropriate markings of applicable testing agency.

1. All Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
2. All Insulation Installed Indoors; Outdoors-Installed Insulation in Contact with Airstream: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
3. All Insulation Installed Indoors and Outdoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.

2.2 INSULATION MATERIALS

A. Comply with requirements in "Duct Insulation Schedule, General," "Indoor Duct and Plenum Insulation Schedule," and "Aboveground, Outdoor Duct and Plenum Insulation Schedule" articles for where insulating materials are to be applied.

B. Products do not contain asbestos, lead, mercury, or mercury compounds.

C. Products that come in contact with stainless steel have a leachable chloride content of less than 50 ppm when tested in accordance with ASTM C871.

D. Insulation materials for use on austenitic stainless steel are qualified as acceptable in accordance with ASTM C795.

E. Foam insulation materials do not use CFC or HCFC blowing agents in the manufacturing process.

F. Glass-Fiber Blanket: Glass fibers bonded with a thermosetting resin; suitable for maximum use temperature up to **450 deg F** in accordance with ASTM C411. Comply with ASTM C553, Type II, and ASTM C1290, Type II with factory-applied vinyl jacket. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

    a. CertainTeed; SAINT-GOBAIN
    b. Johns Manville; a Berkshire Hathaway company
    c. Knauf Insulation
    d. Manson Insulation Inc.
    e. Owens Corning

G. High-Temperature, Glass-Fiber Blanket: Glass fibers bonded with a thermosetting resin, unfaced; suitable for maximum use temperature up to **1000 deg F**. Comply with ASTM C553, Type V.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

    a. CertainTeed; SAINT-GOBAIN
    b. Johns Manville; a Berkshire Hathaway company
    c. Knauf Insulation
    d. Manson Insulation Inc.
    e. Owens Corning

H. Glass-Fiber Board Insulation: Glass fibers bonded with a thermosetting resin; suitable for maximum use temperature between **35 deg F** and **250 deg F** for jacketed and between **35 deg F** and **450 deg F** for unfaced in accordance with ASTM C411. Comply with ASTM C612, Type IA or Type IB. For duct and plenum applications, provide insulation with factory-applied ASJ. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. CertainTeed; SAINT-GOBAIN
b. Johns Manville; a Berkshire Hathaway company
c. Knauf Insulation
d. Manson Insulation Inc.
e. Owens Corning

2. Basis-of-Design Product: Subject to compliance with requirements, provide glass fiberboard insulation or comparable product by one of the following:

a. CertainTeed; SAINT-GOBAIN
b. Johns Manville; a Berkshire Hathaway company
c. Knauf Insulation
d. Manson Insulation Inc.
e. Owens Corning

2.3 FIRE-RATED INSULATION SYSTEMS

A. Fire-Rated Board: Structural-grade, press-molded, xonolite calcium silicate, fireproofing board suitable for operating temperatures up to **1700 deg F**. Comply with ASTM C656, Type II, Grade 6. Tested and certified to provide a 1 -hour fire rating by an NRTL acceptable to authorities having jurisdiction.

1. Manufacturers: Subject to compliance with requirements, provide products by the following:

a. Johns Manville; a Berkshire Hathaway company

2.4 ADHESIVES

A. Materials are compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated unless otherwise indicated.

B. ASJ Adhesive, and FSK Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Childers Brand; H. B. Fuller Construction Products
b. Foster Brand; H. B. Fuller
c. Mon-Eco Industries, Inc.

2. Adhesive shall have a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
3. Adhesive shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

4. Adhesive shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
5. Adhesive shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers." Formaldehyde emissions shall not exceed 9 mcg/cu. m or 7 ppb, whichever is less.
6. Adhesive shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
7. Adhesive shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers." The building concentration of formaldehyde shall not exceed half of the indoor recommended exposure limit, or 33 mcg/cu. m, and that of acetaldehyde shall not exceed 9 mcg/cu. m.

2.5 MASTICS AND COATINGS

A. Materials are compatible with insulation materials, jackets, and substrates.

1. VOC Content: 300 g/L or less.
2. Low-Emitting Materials: Mastic coatings shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
3. VOC Content: 300 g/L or less.
4. Low-Emitting Materials: Mastic coatings shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
5. VOC Content: 300 g/L or less.
6. Low-Emitting Materials: Mastic coatings shall comply with the requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers." Formaldehyde emissions shall not exceed 9 mcg/cu. m or 7 ppb, whichever is less.
7. VOC Content: 300 g/L or less.
8. Low-Emitting Materials: Mastic coatings shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
9. VOC Emissions: Mastic coatings shall contain no more than half of the chronic REL of VOCs when tested according to the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers." The building concentration of formaldehyde shall not exceed half of the indoor

recommended exposure limit or 33 mcg/cu. m and that of acetaldehyde shall not exceed 9 mcg/cu. m.

B. Vapor-Retarder Mastic, Water Based, Interior Use: Suitable for indoor use on below ambient services.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

   a. Aeroflex USA
   b. Childers Brand; H. B. Fuller Construction Products
   c. Foster Brand; H. B. Fuller
   d. Knauf Insulation
   e. Vimasco Corporation

2. Water-Vapor Permeance: Comply with ASTM C755, Section 7.2.2, Table 2, for insulation type and service conditions.
3. Service Temperature Range: **Minus 20 to plus 180 deg F**.
4. Comply with MIL-PRF-19565C, Type II, for permeance requirements , with supplier listing on DOD QPD - Qualified Products Database.
5. Color: White.

2.6 LAGGING ADHESIVES

A. Lagging Adhesives: Comply with MIL-A-3316C, Class I, Grade A and are compatible with insulation materials, jackets, and substrates.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

   a. Childers Brand; H. B. Fuller Construction Products
   b. Foster Brand; H. B. Fuller
   c. Vimasco Corporation

2. Adhesives shall have a VOC content of 50 g/L or less.
3. Adhesive shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
4. Adhesive shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
5. Adhesive shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers." Formaldehyde emissions shall not exceed 9 mcg/cu. m or 7 ppb, whichever is less.

6. Adhesive shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
7. Adhesive shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers." The building concentration of formaldehyde shall not exceed half of the indoor recommended exposure limit, or 33 mcg/cu. m, and that of acetaldehyde shall not exceed 9 mcg/cu. m.
8. Fire-resistant, water-based lagging adhesive and coating for use indoors to adhere fire-resistant lagging cloths over duct insulation.
9. Service Temperature Range: **0 to plus 180 deg F**.
10. Color: White.

2.7 SEALANTS

A. FSK and Metal Jacket Flashing Sealants:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

    a. Childers Brand; H. B. Fuller Construction Products
    b. Eagle Bridges - Marathon Industries
    c. Foster Brand; H. B. Fuller
    d. Mon-Eco Industries, Inc.

2. Materials are compatible with insulation materials, jackets, and substrates.
3. Fire- and water-resistant, flexible, elastomeric sealant.
4. Service Temperature Range: **Minus 40 to plus 250 deg F**.
5. Color: Aluminum.
6. Sealant shall have a VOC content of 420 g/L or less.
7. Sealant shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
8. Sealant shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
9. Sealant shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers." Formaldehyde emissions shall not exceed 9 mcg/cu. m or 7 ppb, whichever is less.
10. Sealant shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

11. Sealant shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers." The building concentration of formaldehyde shall not exceed half of the indoor recommended exposure limit, or 33 mcg/cu. m, and that of acetaldehyde shall not exceed 9 mcg/cu. m.

B. ASJ Flashing Sealants, and Vinyl and PVC Jacket Flashing Sealants:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

    a. Childers Brand; H. B. Fuller Construction Products
    b. Foster Brand; H. B. Fuller

2. Materials are compatible with insulation materials, jackets, and substrates.
3. Fire- and water-resistant, flexible, elastomeric sealant.
4. Service Temperature Range: **Minus 40 to plus 250 deg F**.
5. Color: White.
6. Sealant shall have a VOC content of 420 g/L or less.
7. Sealant shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
8. Sealant shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
9. Sealant shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers." Formaldehyde emissions shall not exceed 9 mcg/cu. m or 7 ppb, whichever is less.
10. Sealant shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
11. Sealant shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers." The building concentration of formaldehyde shall not exceed half of the indoor recommended exposure limit, or 33 mcg/cu. m, and that of acetaldehyde shall not exceed 9 mcg/cu. m.

2.8 FACTORY-APPLIED JACKETS

A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:

1. ASJ: White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C1136, Type I.
2. ASJ-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C1136, Type I.
3. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C1136, Type II.
4. FSP Jacket: Aluminum-foil, fiberglass-reinforced scrim with polyethylene backing; complying with ASTM C1136, Type II.
5. Vinyl Jacket: White vinyl with a permeance of **1.3 perms** when tested in accordance with ASTM E96/E96M, Procedure A, and complying with NFPA 90A and NFPA 90B.
6. ASJ+: All-service jacket composed of aluminum foil reinforced with glass scrim bonded to a kraft paper interleaving with an outer film leaving no paper exposed; complying with ASTM C1136, Types I, II, III, IV, and VII.
7. PSK Jacket: Aluminum foil, fiberglass-reinforced scrim with polyethylene backing; complying with ASTM C1136, Type II.

2.9 FIELD-APPLIED JACKETS

A. Field-applied jackets comply with ASTM C921, Type I, unless otherwise indicated.

B. FSK Jacket: Aluminum-foil-face, fiberglass-reinforced scrim with kraft-paper backing.

C. Metal Jacket:

1. Manufacturers: Subject to compliance with requirements, provide products by the following:

    a. Johns Manville; a Berkshire Hathaway company
    b. RPR Products, Inc.

2. Aluminum Jacket: Comply with **ASTM B209**, Alloy 3003, 3005, 3105, or 5005, Temper H-14.

    a. Sheet and roll stock ready for shop or field sizing.
    b. Finish and thickness are indicated in field-applied jacket schedules.
    c. Moisture Barrier for Indoor Applications: 3-mil- thick, heat-bonded polyethylene and kraft paper.
    d. Moisture Barrier for Outdoor Applications: 3-mil- thick, heat-bonded polyethylene and kraft paper.

3. Stainless Steel Jacket: ASTM A240/A240M.

    a. Sheet and roll stock ready for shop or field sizing.
    b. Material, finish, and thickness are indicated in field-applied jacket schedules.
    c. Moisture Barrier for Indoor Applications: 3-mil- thick, heat-bonded polyethylene and kraft paper.
    d. Moisture Barrier for Outdoor Applications: 3-mil- thick, heat-bonded polyethylene and kraft paper.

2.10 TAPES

A. FSK Tape: Foil-face, vapor-retarder tape matching factory-applied jacket with acrylic adhesive; complying with ASTM C1136.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

    a. 3M Industrial Adhesives and Tapes Division
    b. Avery Dennison Corporation, Specialty Tapes Division
    c. Ideal Tape Co., Inc., an American Biltrite Company
    d. Knauf Insulation

2. Width: 3 inches.
3. Thickness: 6.5 mils.
4. Adhesion: 90 ounces force/inch in width.
5. Elongation: 2 percent.
6. Tensile Strength: 40 lbf/inch in width.
7. FSK Tape Disks and Squares: Precut disks or squares of FSK tape.

2.11 SECUREMENTS

A. Insulation Pins and Hangers:

1. Metal, Adhesively Attached, Perforated-Base Insulation Hangers: Baseplate welded to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:

    a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

        1) AGM Industries, Inc.
        2) Gemco.
        3) Midwest Fasteners, Inc.

    b. Basis-of-Design Product: Subject to compliance with requirements, provide securments or comparable product by one of the following:
    c. Baseplate: Perforated, galvanized carbon-steel sheet, **0.030 inch** thick by **2 inches** square.
    d. Spindle: Copper- or zinc-coated, low-carbon steel, fully annealed, **0.106-inch-** diameter shank, length to suit depth of insulation indicated.
    e. Adhesive: Recommended by hanger manufacturer. Product with demonstrated capability to bond insulation hanger securely to substrates indicated without damaging insulation, hangers, and substrates.

2. Nonmetal, Adhesively Attached, Perforated-Base Insulation Hangers: Baseplate fastened to projecting spindle that is capable of holding insulation, of thickness

indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:

a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1) Gemco.
2) Midwest Fasteners, Inc.

b. Basis-of-Design Product: Subject to compliance with requirements, provide securements or comparable product by one of the following:
c. Baseplate: Perforated, nylon sheet, **0.030 inch** thick by **1-1/2 inches** in diameter.
d. Spindle: Nylon, **0.106-inch-** diameter shank, length to suit depth of insulation indicated, up to **2-1/2 inches**.
e. Adhesive: Recommended by hanger manufacturer. Product with demonstrated capability to bond insulation hanger securely to substrates indicated without damaging insulation, hangers, and substrates.

3. Self-Sticking-Base Insulation Hangers: Baseplate welded to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:

a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1) AGM Industries, Inc.
2) Gemco.
3) Midwest Fasteners, Inc.

b. Basis-of-Design Product: Subject to compliance with requirements, provide securements or comparable product by one of the following:
c. Baseplate: Galvanized carbon-steel sheet, **0.030 inch** thick by **2 inches** square.
d. Spindle: Copper- or zinc-coated, low-carbon steel, fully annealed, **0.106-inch-** diameter shank, length to suit depth of insulation indicated.
e. Adhesive-backed base with a peel-off protective cover.

B. Staples: Outward-clinching insulation staples, nominal **3/4-inch-** wide, stainless steel or Monel.

C. Wire: 0.080-inch nickel-copper alloy.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. C & F Wire Products

b. Johns Manville; a Berkshire Hathaway company
c. RPR Products, Inc.

2.12 CORNER ANGLES

A. PVC Corner Angles: 30 mils thick, minimum **1 by 1 inch**, PVC in accordance with ASTM D1784, Class 16354-C. White or color-coded to match adjacent surface.

B. Aluminum Corner Angles: 0.040 inch thick, minimum **1 by 1 inch**, aluminum in accordance with **ASTM B209**, Alloy 3003, 3005, 3105, or 5005; Temper H-14.

C. Stainless Steel Corner Angles: 0.024 inch thick, minimum **1 by 1 inch**, stainless steel in accordance with ASTM A240/A240M, Type 304 or Type 316.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of insulation application.

1. Verify that systems to be insulated have been tested and are free of defects.
2. Verify that surfaces to be insulated are clean and dry.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.

3.3 GENERAL INSTALLATION REQUIREMENTS

A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of ducts and fittings.

B. Install insulation materials, vapor barriers or retarders, jackets, and thicknesses required for each item of duct system as specified in insulation system schedules.

C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, compress, or otherwise damage insulation or jacket.

D. Install insulation with longitudinal seams at top and bottom of horizontal runs.

E. Install multiple layers of insulation with longitudinal and end seams staggered.

F. Keep insulation materials dry during application and finishing. Replace insulation materials that get wet during storage or in the installation process before being properly covered and sealed in accordance with Contract Documents , unless otherwise approved by the engineer-of-record.

G. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.

H. Install insulation with least number of joints practical.

I. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.

1. Install insulation continuously through hangers and around anchor attachments.
2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.
3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.

J. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.

K. Install insulation with factory-applied jackets as follows:

1. Draw jacket tight and smooth, but not to the extent of creating wrinkles or areas of compression in the insulation.
2. Cover circumferential joints with **3-inch-** wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced **4 inches** o.c.
3. Overlap jacket longitudinal seams at least **1-1/2 inches**. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 2 inches o.c.

    a. For below ambient services, apply vapor-barrier mastic over staples.

4. Cover joints and seams with tape, according to insulation material manufacturer's written instructions, to maintain vapor seal.
5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to duct flanges and fittings.

L. Cut insulation in a manner to avoid compressing insulation.

M. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.

N. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least **4 inches** beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.

3.4 PENETRATIONS

A. Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetrations.

1. Seal penetrations with flashing sealant.
2. For applications requiring only indoor insulation, terminate insulation above roof surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
3. Extend jacket of outdoor insulation outside roof flashing at least **2 inches** below top of roof flashing.
4. Seal jacket to roof flashing with flashing sealant.

B. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.

1. Seal penetrations with flashing sealant.
2. For applications requiring only indoor insulation, terminate insulation inside wall surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
3. Extend jacket of outdoor insulation outside wall flashing and overlap wall flashing at least **2 inches**.
4. Seal jacket to wall flashing with flashing sealant.

C. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.

D. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Terminate insulation at fire damper sleeves for fire-rated wall and partition penetrations. Externally insulate damper sleeves to match adjacent insulation and overlap duct insulation at least **2 inches**.

1. Comply with requirements in Section 078413 "Penetration Firestopping."

E. Insulation Installation at Floor Penetrations:

1. Duct: For penetrations through fire-rated assemblies, terminate insulation at fire damper sleeves and externally insulate damper sleeve beyond floor to match adjacent duct insulation. Overlap damper sleeve and duct insulation at least **2 inches**.
2. Seal penetrations through fire-rated assemblies. Comply with requirements in Section 078413 "Penetration Firestopping."

3.5 INSTALLATION OF FLEXIBLE ELASTOMERIC AND POLYOLEFIN INSULATION

A. Comply with manufacturer's written installation instructions and ASTM C1710.

B. Seal longitudinal seams and end joints with manufacturer's recommended adhesive to

eliminate openings in insulation that allow passage of air to surface being insulated.

C. Square and Rectangular Ducts and Plenums:

1. Provide **1/4 inch** more per side for a tight, compression fit.
2. Cut sheet insulation with the following dimensions:

    a. Width of duct plus **1/4 inch**, one piece.
    b. Height of duct plus **1/4 inch**, plus thickness of insulation, two pieces.
    c. Width of duct plus **1/4 inch**, plus two times the thickness of insulation, one piece.

3. Insulate the bottom of the duct with the sheet from (a) above, then the sides with the two sheets from (b) above, and finally the top of the duct with the sheet from (c) above.
4. Insulation without self-adhering backing:

    a. Apply 100 percent coverage of manufacturer adhesive on the metal surface, then the insulation, except for the last **1/4 inch** where sheets will butt together.
    b. Roll sheet down into position.
    c. Press two sheets together under compression and apply adhesive at the butt joint to seal the two sheets together.

5. Insulation with self-adhering backing:

    a. Peel back release paper in **6- to 8-inch** increments and line up sheet.
    b. Press firmly to activate adhesive.
    c. Align material and continue to line up correctly, pressing firmly while slowly removing release paper.
    d. Allow **1/4-inch** overlap for compression at butt joints.
    e. Apply adhesive at the butt joint to seal the two sheets together.

6. Insulate duct brackets following manufacturer's written installation instructions.

D. Circular Ducts:

1. Determine the circumference of the duct, using a strip of insulation the same thickness as to be used.
2. Cut the sheet to the required size.
3. Apply 100 percent coverage of manufacturer adhesive on the metal surface then the insulation.
4. Apply manufacturer adhesive to the cut surfaces along 100 percent of the longitudinal seam. Press together the seam at the ends and then the middle. Close the entire seam starting from the middle.

3.6 INSTALLATION OF GLASS-FIBER AND MINERAL-WOOL INSULATION

A. Blanket Insulation Installation on Ducts and Plenums: Secure with adhesive and insulation pins.

B. Comply with manufacturer's written installation instructions.

1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 100 percent coverage of duct and plenum surfaces.
2. Apply adhesive to entire circumference of ducts and to all surfaces of fittings and transitions.
3. Install either capacitor-discharge-weld pins and speed washers or cupped-head, capacitor-discharge-weld pins on sides and bottom of horizontal ducts and sides of vertical ducts as follows:

    a. On duct sides with dimensions **18 inches** and smaller, place pins along longitudinal centerline of duct. Space **3 inches** maximum from insulation end joints, and **16 inches** o.c.
    b. On duct sides with dimensions larger than **18 inches**, place pins **16 inches** o.c. each way, and **3 inches** maximum from insulation joints. Install additional pins to hold insulation tightly against surface at cross bracing.
    c. Pins may be omitted from top surface of horizontal, rectangular ducts and plenums.
    d. Do not overcompress insulation during installation.
    e. Impale insulation over pins and attach speed washers.
    f. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.

4. For ducts and plenums with surface temperatures below ambient, install a continuous unbroken vapor barrier. Create a facing lap for longitudinal seams and end joints with insulation by removing **2 inches** from one edge and one end of insulation segment. Secure laps to adjacent insulation section with **1/2-inch** outward-clinching staples, **1 inch** o.c. Install vapor barrier consisting of factory- or field-applied jacket, adhesive, vapor-barrier mastic, and sealant at joints, seams, and protrusions.

    a. Repair punctures, tears, and penetrations with tape or mastic to maintain vapor-barrier seal.
    b. Install vapor stops for ductwork and plenums operating below **50 deg F** at **18-foot** intervals. Vapor stops consist of vapor-barrier mastic applied in a Z-shaped pattern over insulation face, along butt end of insulation, and over the surface. Cover insulation face and surface to be insulated a width equal to two times the insulation thickness, but not less than **3 inches**.

5. Overlap unfaced blankets a minimum of **2 inches** on longitudinal seams and end joints. At end joints, secure with steel bands spaced a maximum of **18 inches** o.c.
6. Install insulation on rectangular duct elbows and transitions with a full insulation section for each surface. Install insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.
7. Insulate duct stiffeners, hangers, and flanges that protrude beyond insulation surface with **6-inch-** wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced **6 inches** o.c.

C. Board Insulation Installation on Ducts and Plenums: Secure with adhesive and insulation pins.

1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 100 percent coverage of duct and plenum surfaces.
2. Apply adhesive to entire circumference of ducts and to all surfaces of fittings and transitions.
3. Install either capacitor-discharge-weld pins and speed washers or cupped-head, capacitor-discharge-weld pins on sides and bottom of horizontal ducts and sides of vertical ducts as follows:

    a. On duct sides with dimensions **18 inches** and smaller, place pins along longitudinal centerline of duct. Space **3 inches** maximum from insulation end joints, and **16 inches** o.c.
    b. On duct sides with dimensions larger than **18 inches**, space pins **16 inches** o.c. each way, and **3 inches** maximum from insulation joints. Install additional pins to hold insulation tightly against surface at cross bracing.
    c. Pins may be omitted from top surface of horizontal, rectangular ducts and plenums.
    d. Do not overcompress insulation during installation.
    e. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.

4. For ducts and plenums with surface temperatures below ambient, install a continuous unbroken vapor barrier. Create a facing lap for longitudinal seams and end joints with insulation by removing **2 inches** from one edge and one end of insulation segment. Secure laps to adjacent insulation section with **1/2-inch** outward-clinching staples, **1 inch** o.c. Install vapor barrier consisting of factory- or field-applied jacket, adhesive, vapor-barrier mastic, and sealant at joints, seams, and protrusions.

    a. Repair punctures, tears, and penetrations with tape or mastic to maintain vapor-barrier seal.
    b. Install vapor stops for ductwork and plenums operating below **50 deg F** at **18-foot** intervals. Vapor stops consist of vapor-barrier mastic applied in a Z-shaped pattern over insulation face, along butt end of insulation, and over the surface. Cover insulation face and surface to be insulated a width equal to two times the insulation thickness, but not less than **3 inches**.

5. Install insulation on rectangular duct elbows and transitions with a full insulation section for each surface. Groove and score insulation to fit as closely as possible to outside and inside radius of elbows. Install insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.
6. Insulate duct stiffeners, hangers, and flanges that protrude beyond insulation surface with **6-inch-** wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced **6 inches** o.c.

3.7 FIELD-APPLIED JACKET INSTALLATION

A. Where glass-cloth jackets are indicated, install directly over bare insulation or insulation with factory-applied jackets.

1. Draw jacket smooth and tight to surface with **2-inch** overlap at seams and joints.
2. Embed glass cloth between two **0.062-inch-** thick coats of lagging adhesive.
3. Completely encapsulate insulation with coating, leaving no exposed insulation.

B. Where FSK jackets are indicated, install as follows:

1. Draw jacket material smooth and tight.
2. Install lap or joint strips with same material as jacket.
3. Secure jacket to insulation with manufacturer's recommended adhesive.
4. Install jacket with **1-1/2-inch** laps at longitudinal seams and **3-inch-** wide joint strips at end joints.
5. Seal openings, punctures, and breaks in vapor-retarder jackets and exposed insulation with vapor-barrier mastic.

C. Where PVC jackets are indicated, install with **1-inch** overlap at longitudinal seams and end joints; for horizontal applications, install with longitudinal seams along top and bottom of tanks and vessels. Seal with manufacturer's recommended adhesive.

1. Apply two continuous beads of adhesive to seams and joints, one bead under lap and the finish bead along seam and joint edge.

D. Where metal jackets are indicated, install with **2-inch** overlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal end joints with weatherproof sealant recommended by insulation manufacturer. Secure jacket with stainless steel bands **12 inches** o.c. and at end joints.

3.8 FIRE-RATED INSULATION SYSTEM INSTALLATION

A. Comply with manufacturer's written installation instructions.

B. Where fire-rated insulation system is indicated, secure system to ducts and duct hangers and supports to maintain a continuous fire rating.

C. Insulate duct access panels and doors to achieve same fire rating as duct.

D. Install firestopping at penetrations through fire-rated assemblies. Fire-stop systems are specified in Section 078413 "Penetration Firestopping."

3.9 FINISHES

A. Insulation with ASJ, Glass-Cloth, or Other Paintable Jacket Material: Paint jacket with paint system identified below and as specified in Section 099113 "Exterior Painting" and Section 099123 "Interior Painting."

1. Flat Acrylic Finish: Two finish coats over a primer that is compatible with jacket

material and finish coat paint. Add fungicidal agent to render fabric mildew proof.

a. Finish Coat Material: Interior, flat, latex-emulsion size.

B. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of insulation manufacturer's recommended protective coating.

C. Color: Final color as selected by Architect. Vary first and second coats to allow visual inspection of the completed Work.

D. Do not field paint aluminum or stainless steel jackets.

3.10 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Perform tests and inspections.

C. Tests and Inspections:

1. Inspect ductwork, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection is limited to one location(s) for each duct system defined in the "Duct Insulation Schedule, General" Article.

D. All insulation applications will be considered defective Work if sample inspection reveals noncompliance with requirements.

3.11 DUCT INSULATION SCHEDULE, GENERAL

A. Plenums and Ducts Requiring Insulation:

1. Indoor, concealed supply and outdoor air.
2. Indoor, exposed supply and outdoor air.
3. Indoor, concealed return located in unconditioned space.
4. Indoor, exposed return located in unconditioned space.
5. Indoor, concealed, Type I, commercial, kitchen hood exhaust.
6. Indoor, exposed, Type I, commercial, kitchen hood exhaust.
7. Indoor, concealed oven and warewash exhaust.
8. Indoor, exposed oven and warewash exhaust.
9. Indoor, concealed exhaust between isolation damper and penetration of building exterior.
10. Indoor, exposed exhaust between isolation damper and penetration of building exterior.
11. Outdoor, concealed supply and return.
12. Outdoor, exposed supply and return.

B. Items Not Insulated:

1. Fibrous-glass ducts.

2. Metal ducts with duct liner of sufficient thickness to comply with energy code and ASHRAE/IESNA 90.1.
3. Factory-insulated flexible ducts.
4. Factory-insulated plenums and casings.
5. Flexible connectors.
6. Vibration-control devices.
7. Factory-insulated access panels and doors.

3.12 INDOOR DUCT AND PLENUM INSULATION SCHEDULE

A. Concealed, round and flat-oval, supply-air duct insulation is one of the following:

1. Flexible Elastomeric: 1 inch thick.
2. Glass-Fiber Blanket: 2 inches thick and 1.5 lb/cu. ft. nominal density.
3. Mineral Wool Blanket: 2 inches thick and 4 lb/cu. ft. nominal density.
4. Polyolefin: 1 inch thick.

B. Concealed, round and flat-oval, return-air duct insulation is one of the following:

1. Flexible Elastomeric: 1 inch thick.
2. Glass-Fiber Blanket: 2 inches thick and 1.5 lb/cu. ft. nominal density.
3. Mineral Wool Blanket: 2 inches thick and 4 lb/cu. ft. nominal density.
4. Polyolefin: 1 inch thick.

C. Concealed, round and flat-oval, outdoor-air duct insulation is one of the following:

1. Flexible Elastomeric: 1 inch thick.
2. Glass-Fiber Blanket: 2 inches thick and 1.5 lb/cu. ft. nominal density.
3. Mineral Wool Blanket: 2 inches thick and 4 lb/cu. ft. nominal density.
4. Polyolefin: 1 inch thick.

D. Concealed, round and flat-oval, exhaust-air duct insulation is one of the following:

1. Flexible Elastomeric: 1 inch thick.
2. Glass-Fiber Blanket: 2 inches thick and 1.5 lb/cu. ft. nominal density.
3. Mineral Wool Blanket: 2 inches thick and 4 lb/cu. ft. nominal density.
4. Polyolefin: 1 inch thick.

E. Concealed, rectangular, supply-air duct insulation is one of the following:

1. Flexible Elastomeric: 1 inch thick.
2. Glass-Fiber Blanket: 2 inches thick and 1.5 lb/cu. ft. nominal density.
3. Glass-Fiber Board: 2 inches thick and 2 lb/cu. ft. nominal density.
4. Mineral Wool Blanket: 2 inches thick and 4 lb/cu. ft. nominal density.
5. Mineral Wool Board: 2 inches thick and 4 lb/cu. ft. nominal density.
6. Polyolefin: 1 inch thick.

F. Concealed, rectangular, return-air duct insulation is one of the following:

1. Flexible Elastomeric: 1 inch thick.

2. Glass-Fiber Blanket: 2 inches thick and 1.5 lb/cu. ft. nominal density.
3. Glass-Fiber Board: 2 inches thick and 2 lb/cu. ft. nominal density.
4. Mineral Wool Blanket: 2 inches thick and 4 lb/cu. ft. nominal density.
5. Mineral Wool Board: 2 inches thick and 4 lb/cu. ft. nominal density.
6. Polyolefin: 1 inch thick.

G. Concealed, rectangular, outdoor-air duct insulation is one of the following:

1. Flexible Elastomeric: 1 inch thick.
2. Glass-Fiber Blanket: 2 inches thick and 1.5 lb/cu. ft. nominal density.
3. Glass-Fiber Board: 2 inches thick and 2 lb/cu. ft. nominal density.
4. Mineral Wool Blanket: 2 inches thick and 4 lb/cu. ft. nominal density.
5. Mineral Wool Board: 2 inches thick and 4 lb/cu. ft. nominal density.
6. Polyolefin: 1 inch thick.

H. Concealed, rectangular, exhaust-air duct insulation between isolation damper and penetration of building exterior is one of the following:

1. Flexible Elastomeric: 1 inch thick.
2. Glass-Fiber Blanket: 2 inches thick and 1.5 lb/cu. ft. nominal density.
3. Glass-Fiber Board: 2 inches thick and 2 lb/cu. ft. nominal density.
4. Mineral Wool Blanket: 2 inches thick and 4 lb/cu. ft. nominal density.
5. Mineral Wool Board: 2 inches thick and 4 lb/cu. ft. nominal density.
6. Polyolefin: 1 inch thick.

I. Concealed, Type I, Commercial, Kitchen Hood Exhaust Duct and Plenum Insulation: Fire-rated blanket or board; thickness as required to achieve 2-hour fire rating.

J. Concealed, supply-air plenum insulation is one of the following:

1. Flexible Elastomeric: 1 inch thick.
2. Glass-Fiber Blanket: 2 inches thick and 1.5 lb/cu. ft. nominal density.
3. Glass-Fiber Board: 2 inches thick and 2 lb/cu. ft. nominal density.
4. Mineral Wool Blanket: 2 inches thick and 4 lb/cu. ft. nominal density.
5. Mineral Wool Board: 2 inches thick and 4 lb/cu. ft. nominal density.
6. Polyolefin: 1 inch thick.

K. Concealed, return-air plenum insulation is one of the following:

1. Flexible Elastomeric: 1 inch thick.
2. Glass-Fiber Blanket: 2 inches thick and 1.5 lb/cu. ft. nominal density.
3. Glass-Fiber Board: 2 inches thick and 2 lb/cu. ft. nominal density.
4. Mineral Wool Blanket: 2 inches thick and 4 lb/cu. ft. nominal density.
5. Mineral Wool Board: 2 inches thick and 4 lb/cu. ft. nominal density.
6. Polyolefin: 1 inch thick.

L. Concealed, outdoor-air plenum insulation is one of the following:

1. Glass-Fiber Blanket: 2 inches thick and 1.5 lb/cu. ft. nominal density.
2. Glass-Fiber Board: 2 inches thick and 2 lb/cu. ft. nominal density.
3. Mineral Wool Blanket: 2 inches thick and 4 lb/cu. ft. nominal density.

4. Mineral Wool Board: 2 inches thick and 4 lb/cu. ft. nominal density.

M. Concealed, exhaust-air plenum insulation is one of the following:

1. Glass-Fiber Blanket: 2 inches thick and 1.5 lb/cu. ft. nominal density.
2. Glass-Fiber Board: 2 inches thick and 2 lb/cu. ft. nominal density.
3. Mineral Wool Blanket: 2 inches thick and 4 lb/cu. ft. nominal density.
4. Mineral Wool Board: 2 inches thick and 4 lb/cu. ft. nominal density.

N. Exposed, round and flat-oval, supply-air duct insulation is one of the following:

1. Flexible Elastomeric: 1 inch thick.
2. Glass-Fiber Blanket: 2 inches thick and 1.5 lb/cu. ft. nominal density.
3. Glass-Fiber Pipe and Tank: 2 inches thick.
4. Mineral Wool Blanket: 2 inches thick and 4 lb/cu. ft. nominal density.
5. Mineral Wool Pipe and Tank: 2 inches thick.
6. Polyolefin: 1 inch thick.

O. Exposed, round and flat-oval, return-air duct insulation is one of the following:

1. Flexible Elastomeric: 1 inch thick.
2. Glass-Fiber Blanket: 2 inches thick and 1.5 lb/cu. ft. nominal density.
3. Glass-Fiber Pipe and Tank: 2 inches thick.
4. Mineral Wool Blanket: 2 inches thick and 4 lb/cu. ft. nominal density.
5. Mineral Wool Pipe and Tank: 2 inches thick.
6. Polyolefin: 1 inch thick.

P. Exposed, round and flat-oval, outdoor-air duct insulation is one of the following:

1. Flexible Elastomeric: 1 inch thick.
2. Glass-Fiber Blanket: 2 inches thick and 1.5 lb/cu. ft. nominal density.
3. Glass-Fiber Pipe and Tank: 2 inches thick.
4. Mineral Wool Blanket: 2 inches thick and 4 lb/cu. ft. nominal density.
5. Mineral Wool Pipe and Tank: 2 inches thick.
6. Polyolefin: 1 inch thick.

Q. Exposed, round and flat-oval, exhaust-air duct insulation is one of the following:

1. Flexible Elastomeric: 1 inch thick.
2. Glass-Fiber Blanket: 2 inches thick and3 lb/cu. ft. nominal density.
3. Glass-Fiber Pipe and Tank: 2 inches thick.
4. Mineral Wool Blanket: 2 inches thick and 4 lb/cu. ft. nominal density.
5. Mineral Wool Pipe and Tank: 2 inches thick.
6. Polyolefin: 1 inch thick.

R. Exposed, rectangular, supply-air duct insulation is one of the following:

1. Flexible Elastomeric: 1 inch thick.
2. Glass-Fiber Blanket: 2 inches thick and 1.5 lb/cu. ft. nominal density.
3. Glass-Fiber Board: 2 inches thick and 2 lb/cu. ft. nominal density.
4. Mineral Wool Blanket: 2 inches thick and 4 lb/cu. ft. nominal density.

5. Mineral Wool Board: 2 inches thick and 4-lb/cu. ft. nominal density.
6. Polyolefin: 1 inch thick.

S. Exposed, rectangular, return-air duct insulation is one of the following:

1. Flexible Elastomeric: 1 inch thick.
2. Glass-Fiber Blanket: 2 inches thick and 1.5 lb/cu. ft. nominal density.
3. Glass-Fiber Board: 2 inches thick and 2 lb/cu. ft. nominal density.
4. Mineral Wool Blanket: 2 inches thick and 4 lb/cu. ft. nominal density.
5. Mineral Wool Board: 2 inches thick and 4 lb/cu. ft. nominal density.
6. Polyolefin: 1 inch thick.

T. Exposed, rectangular, outdoor-air duct insulation is one of the following:

1. Flexible Elastomeric: 1 inch thick.
2. Glass-Fiber Blanket: 2 inches thick and 1.5 lb/cu. ft. nominal density.
3. Glass-Fiber Board: 2 inches thick and 2 lb/cu. ft. nominal density.
4. Mineral Wool Blanket: 2 inches thick and 4 lb/cu. ft. nominal density.
5. Mineral Wool Board: 2 inches thick and 4 lb/cu. ft. nominal density.
6. Polyolefin: 1 inch thick.

U. Exposed, rectangular, exhaust-air duct insulation is one of the following:

1. Flexible Elastomeric: 1 inch thick.
2. Glass-Fiber Blanket: 2 inches thick and 1.5 lb/cu. ft. nominal density.
3. Glass-Fiber Board: 2 inches thick and 2 lb/cu. ft. nominal density.
4. Mineral Wool Blanket: 2 inches thick and 4 lb/cu. ft. nominal density.
5. Mineral Wool Board: 2 inches thick and 4 lb/cu. ft. nominal density.
6. Polyolefin: 1 inch thick.

V. Exposed, Type I, Commercial, Kitchen Hood Exhaust Duct and Plenum Insulation: Fire-rated blanket or board; thickness as required to achieve 2-hour fire rating.

W. Exposed, supply-air plenum insulation is one of the following:

1. Flexible Elastomeric: 1 inch thick.
2. Glass-Fiber Blanket: 2 inches thick and 1.5 lb/cu. ft. nominal density.
3. Glass-Fiber Board: 2 inches thick and 2 lb/cu. ft. nominal density.
4. Mineral Wool Blanket: 2 inches thick and 4 lb/cu. ft. nominal density.
5. Mineral Wool Board: 2 inches thick and 4 lb/cu. ft. nominal density.
6. Polyolefin: 1 inch thick.

X. Exposed, return-air plenum insulation is one of the following:

1. Flexible Elastomeric: 1 inch thick.
2. Glass-Fiber Blanket: 2 inches thick and 1.5 lb/cu. ft. nominal density.
3. Glass-Fiber Board: 2 inches thick and 2 lb/cu. ft. nominal density.
4. Mineral Wool Blanket: 2 inches thick and 4 lb/cu. ft. nominal density.
5. Mineral Wool Board: 2 inches thick and 4 lb/cu. ft. nominal density.
6. Polyolefin: 1 inch thick.

Y. Exposed, outdoor-air plenum insulation is one of the following:

1. Glass-Fiber Blanket: 2 inches thick and 1.5 lb/cu. ft. nominal density.
2. Glass-Fiber Board: 2 inches thick and 2 lb/cu. ft. nominal density.
3. Mineral Wool Blanket: 2 inches thick and 4 lb/cu. ft. nominal density.
4. Mineral Wool Board: 2 inches thick and 4 lb/cu. ft. nominal density.

Z. Exposed, exhaust-air plenum insulation is one of the following:

1. Glass-Fiber Blanket: 2 inches thick and 1.5 lb/cu. ft. nominal density.
2. Glass-Fiber Board: 2 inches thick and 2 lb/cu. ft. nominal density.
3. Mineral Wool Blanket: 2 inches thick and 4 lb/cu. ft. nominal density.
4. Mineral Wool Board: 2 inches thick and 4 lb/cu. ft. nominal density.

3.13 ABOVEGROUND, OUTDOOR DUCT AND PLENUM INSULATION SCHEDULE

A. Insulation materials and thicknesses are identified below. If more than one material is listed for a duct system, selection from materials listed is Contractor's option.

B. Concealed, round and flat-oval, supply-air duct insulation is one of the following:

1. Glass-Fiber Blanket: 3 inches and 3 lb/cu. ft. nominal density.
2. Mineral Wool Blanket: 2 inches thick and 6 lb/cu. ft. nominal density.

C. Concealed, round and flat-oval, return-air duct insulation is one of the following:

1. Glass-Fiber Blanket: 3 inches and 3 lb/cu. ft. nominal density.
2. Mineral Wool Blanket: 2 inches thick and 6 lb/cu. ft. nominal density.

D. Concealed, round and flat-oval, outdoor-air duct insulation is one of the following:

1. Glass-Fiber Blanket: 3 inches and 3 lb/cu. ft. nominal density.
2. Mineral Wool Blanket: 2 inches thick and 6 lb/cu. ft. nominal density.

E. Concealed, rectangular, supply-air duct insulation is one of the following:

1. Glass-Fiber Blanket: 3 inches and 3 lb/cu. ft. nominal density.
2. Glass-Fiber Board: 3 inches thick and 6 lb/cu. ft. nominal density.
3. Mineral Wool Blanket: 2 inches thick and 6 lb/cu. ft. nominal density.
4. Mineral Wool Board: 2 inches thick and 6 lb/cu. ft. nominal density.

F. Concealed, rectangular, return-air duct insulation is one of the following:

1. Glass-Fiber Blanket: 3 inches and 3 lb/cu. ft. nominal density.
2. Glass-Fiber Board: 3 inches thick and 6 lb/cu. ft. nominal density.
3. Mineral Wool Blanket: 2 inches thick and 6 lb/cu. ft. nominal density.
4. Mineral Wool Board: 2 inches thick and 6 lb/cu. ft. nominal density.

G. Concealed, supply-air plenum insulation is one of the following:

1. Glass-Fiber Blanket: 3 inches and 3 lb/cu. ft. nominal density.

2. Glass-Fiber Board: 3 inches thick and 6 lb/cu. ft. nominal density.
3. Mineral Wool Blanket: 2 inches thick and 6 lb/cu. ft. nominal density.
4. Mineral Wool Board: 2 inches thick and 6 lb/cu. ft. nominal density.

H. Concealed, return-air plenum insulation is one of the following:

1. Glass-Fiber Blanket: 3 inches and 3 lb/cu. ft. nominal density.
2. Glass-Fiber Board: 3 inches thick and 6 lb/cu. ft. nominal density.
3. Mineral Wool Blanket: 2 inches thick and 6 lb/cu. ft. nominal density.
4. Mineral Wool Board: 2 inches thick and 6 lb/cu. ft. nominal density.

I. Exposed, round and flat-oval, supply-air duct insulation is one of the following:

1. Glass-Fiber Blanket: 3 inches and 3 lb/cu. ft. nominal density.
2. Glass-Fiber Pipe and Tank: 3 inches thick.
3. Mineral Wool Blanket: 2 inches thick and 6 lb/cu. ft. nominal density.
4. Mineral Wool Pipe and Tank: 2 inches thick.

J. Exposed, round and flat-oval, return-air duct insulation is one of the following:

1. Glass-Fiber Blanket: 3 inches and 3 lb/cu. ft. nominal density.
2. Glass-Fiber Board: 3 inches thick and 6 lb/cu. ft. nominal density.
3. Mineral Wool Blanket: 3 inches thick and 6 lb/cu. ft. nominal density.
4. Mineral Wool Board: 3 inches thick and 6 lb/cu. ft. nominal density.

K. Exposed, rectangular, supply-air duct insulation is one of the following:

1. Glass-Fiber Blanket: 3 inches and 3 lb/cu. ft. nominal density.
2. Glass-Fiber Board: 3 inches thick and 6 lb/cu. ft. nominal density.
3. Mineral Wool Blanket: 3 inches thick and 6 lb/cu. ft. nominal density.
4. Mineral Wool Board: 3 inches thick and 6 lb/cu. ft. nominal density.

L. Exposed, rectangular, return-air duct insulation is one of the following:

1. Glass-Fiber Blanket: 3 inches and 3 lb/cu. ft. nominal density.
2. Glass-Fiber Board: 3 inches thick and 6 lb/cu. ft. nominal density.
3. Mineral Wool Blanket: 3 inches thick and 6 lb/cu. ft. nominal density.
4. Mineral Wool Board: 3 inches thick and 6 lb/cu. ft. nominal density.

M. Exposed, supply-air plenum insulation is one of the following:

1. Glass-Fiber Blanket: 3 inches and 3 lb/cu. ft. nominal density.
2. Glass-Fiber Board: 3 inches thick and 6 lb/cu. ft. nominal density.
3. Mineral Wool Blanket: 3 inches thick and 6 lb/cu. ft. nominal density.
4. Mineral Wool Board: 3 inches thick and 6 lb/cu. ft. nominal density.

N. Exposed, return-air plenum insulation is one of the following:

1. Glass-Fiber Blanket: 3 inches and 3 lb/cu. ft. nominal density.
2. Glass-Fiber Board: 3 inches thick and 6 lb/cu. ft. nominal density.
3. Mineral Wool Blanket: 3 inches thick and 6 lb/cu. ft. nominal density.

4. Mineral Wool Board: 3 inches thick and 6 lb/cu. ft. nominal density.

3.14 INDOOR, FIELD-APPLIED JACKET SCHEDULE

A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.

B. If more than one material is listed, selection from materials listed is Contractor's option.

C. Ducts and Plenums, Concealed:

1. None.
2. PVC, Color-Coded by System: 30 mils thick.
3. Aluminum, Corrugated: 0.016 inch thick.
4. Painted Aluminum, Smooth: 0.016 inch thick.
5. Stainless Steel, Type 304 or Type 316, Smooth 2B Finish: 0.010 inch thick.

D. Ducts and Plenums, Exposed:

1. None.
2. PVC, Color-Coded by System: 30 mils thick.
3. Aluminum, Corrugated: 0.016 inch thick.
4. Painted Aluminum, Smooth: 0.016 inch thick.
5. Stainless Steel, Type 304 or Type 316, Smooth 2B Finish: 0.010 inch thick.

3.15 OUTDOOR, FIELD-APPLIED JACKET SCHEDULE

A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.

B. If more than one material is listed, selection from materials listed is Contractor's option.

C. Ducts and Plenums, Concealed:

1. None.
2. PVC, Color-Coded by System: 30 mils thick.
3. Aluminum, Corrugated: 0.016 inch thick.
4. Painted Aluminum, Smooth: 0.016 inch thick.
5. Stainless Steel, Type 304 or Type 316, Smooth 2B Finish: 0.010 inch thick.

D. Ducts and Plenums, Exposed, up to **48 Inches** in Diameter or with Flat Surfaces up to **72 Inches**:

1. Aluminum, Corrugated: 0.016 inch thick.
2. Painted Aluminum, Smooth: 0.016 inch thick.
3. Stainless Steel, Type 304 or Type 316, Smooth 2B Finish: 0.010 inch thick.

E. Ducts and Plenums, Exposed, Larger Than **48 Inches** in Diameter or with Flat Surfaces Larger Than **72 Inches**:

1. Painted Aluminum, Smooth with 1-1/4-Inch- Deep Corrugations: 0.032 inch thick.
2. Stainless Steel, Type 304 or Type 316, Smooth, with 1-1/4-Inch- Deep Corrugations: 0.020 inch thick.

END OF SECTION 23 07 13

SECTION 23 09 23.12 - CONTROL DAMPERS

PART 1 - GENERAL

1.1 SUMMARY

A. Related Requirements:

1. Section 230923 "Direct Digital Control (DDC) System for HVAC" for control equipment and software, relays, electrical power devices, uninterruptible power supply units, wire, and cable.
2. Section 230993.11 "Sequence of Operations for HVAC DDC" for requirements that relate to this Section.

1.2 DEFINITIONS

A. DDC: Direct digital control.

B. RMS: Root-mean-square value of alternating voltage, which is the square root of the mean value of the square of the voltage values during a complete cycle.

C. Thermal Efficiency Ratio (E): Comparison of a tested damper's thermal performance against a v-groove blade reference damper. A damper with the same thermal efficiency as the reference damper would have an E value of 0 percent, while a damper that is 4 times as efficient would have an E value of 200 percent.

1.3 ACTION SUBMITTALS

A. Product Data:

1. Rectangular control dampers with airfoil blades.
2. Rectangular control dampers with flat blades.
3. Rectangular control dampers with insulated blades.
4. Rectangular control dampers with integral airflow monitoring.
5. Rectangular control dampers with integral airflow control.
6. Rectangular industrial-duty control dampers.
7. Round control dampers.
8. Round industrial-duty control dampers.
9. Electric and electronic control-damper actuators.
10. Pneumatic control-damper actuators.

B. Product Data Submittals: For each damper and actuator.

1. Construction details, material descriptions, dimensions of individual components and profiles, and finishes.
2. Operating characteristics, electrical characteristics, and furnished accessories indicating process operating range, accuracy over range, control signal over

range, default control signal with loss of power, calibration data specific to each unique application, electrical power requirements, and limitations of ambient operating environment, including temperature and humidity.
3. Product description with complete technical data, performance curves, and product specification sheets.
4. Installation instructions, including factors affecting performance.

C. Shop Drawings:

1. Include plans, elevations, sections, and mounting details.
2. Include details of product assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
3. Include diagrams for power, signal, and control wiring.
4. Include diagrams for pneumatic signal and main air tubing.

D. Delegated Design Submittals:

1. Schedule and design calculations for control dampers and actuators, including the following:

a. Unique designation for each damper/actuator assembly.
b. Service/application.
c. Damper assembly size.
d. Damper assembly weight, including actuator(s).
e. Damper and actuator action (modulating or two position).
f. Flow at project design and minimum flow conditions.
g. Face velocity at project design and minimum airflow conditions.
h. Pressure drop across damper at project design and minimum airflow conditions.
i. AMCA 500D damper installation arrangement used to calculate and schedule pressure drop, as applicable to installation.
j. Maximum close-off pressure.
k. Leakage airflow at maximum system pressure differential (fan close-off pressure).
l. Damper torque required at worst-case condition for sizing actuator.
m. Actuator selection indicating torque provided.
n. Actuator fail-safe position on loss of power and loss of signal.
o. Remarks listing special requirements.

1.4 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Plan drawings and corresponding product installation details, drawn to scale, on which the following items are indicated and coordinated with each other, using input from installers of the items involved:

1. Product installation location indicated in relationship to room, duct, and equipment.
2. Size and location of wall access panels for control dampers and actuators installed behind walls.

3. Size and location of ceiling access panels for control dampers and actuators installed above inaccessible ceilings.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For control dampers.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. ASHRAE 62.1 Compliance: Applicable outdoor ventilation requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and Startup."

C. ASHRAE/IES 90.1 Compliance: Applicable requirements in ASHRAE/IES 90.1, Section 6 - "Heating, Ventilating, and Air-Conditioning."

D. Code Compliance: Comply with governing energy code.

E. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to size products where indicated as delegated design.

F. Ground Fault: Properly ground products to prevent failing due to ground fault conditions.

G. Backup Power Source: Serve control-damper actuators from a backup power source where associated with systems and equipment served by a backup power source.

H. Environmental Conditions: For actuators not available with integral enclosures complying with requirements indicated, house in protective secondary enclosures complying with requirements.

I. Selection Criteria:

1. Multi-Blade Damper Configuration: As follows unless otherwise indicated on Drawings:

    a. Two-Position Control: Opposed or parallel.
    b. Equipment Isolation Applications: Opposed or parallel.
    c. Face and Bypass Applications: Opposed or parallel.
    d. Outdoor/Return Air-Mixing Applications: Opposed or parallel.
    e. All Other Applications: Opposed or parallel.

2. Fail-Safe Positions: As follows unless otherwise indicated on Drawings:

a. Supply Air: Last position.
b. Return Air: Last position.
c. Outdoor Air: Close.
d. Mixed Air: Last position.
e. Exhaust Air: Close.

3. Select dampers with smooth and stable operation throughout full range of operation over varying pressures and temperatures encountered.
4. Sizing: As follows unless otherwise indicated on Drawings

a. Modulating Dampers: Select damper size for a pressure drop of 5% percent of fan total static pressure unless otherwise indicated.
b. Two-Position Dampers: Full size of duct or equipment connection unless otherwise indicated.

5. Pneumatic, Two-Position Control-Damper Opening and Closing Characteristic:

a. Provide a smooth opening and closing characteristic slow enough to avoid an excessive rapid change in system pressure.
b. Provide an adjustable opening time (full closed to full open) and an adjustable closing time (full open to full closed) ranging from zero to 15 seconds. Make opening and closing times independently adjustable.

6. Pneumatic Control Signal Distance Limitation: Not to exceed 100 ft. from controller. For longer distances, provide an electric/electronic control signal to the damper/actuator and an electric solenoid valve or electro-pneumatic transducer locally at the damper/actuator to convert the control signal to pneumatic.

2.2 GENERAL CONTROL-DAMPER ACTUATORS REQUIREMENTS

A. Select actuators to operate related damper(s) with sufficient reserve power to provide smooth modulating action or two-position action and proper speed of response at velocity and pressure conditions to which the damper is subjected.

B. Select actuators with sufficient power and torque to close off against the maximum system pressures encountered. Actuators are to be sized to close off against the fan shutoff pressure as a minimum requirement.

C. The total damper area operated by an actuator is not to exceed 80 percent of manufacturer's maximum area rating.

D. Provide one actuator for each damper assembly where possible. Operate multiple actuators required to drive a single damper assembly in unison.

E. Avoid the use of excessively oversized actuators, which could overdrive and cause linkage failure when the damper blade has reached either its full open or closed position.

F. Use jackshafts and shaft couplings in lieu of blade-to-blade linkages when driving axially aligned damper sections.

G. Provide mounting hardware and linkages for connecting actuator to damper.

H. Select actuators to fail-safe in desired position in the event of a power and signal failure.

I. Actuator Fail-Safe Positions: As indicated below:

1. Exhaust Air: Close.
2. Outdoor Air: Close.
3. Supply Air: Last position.
4. Return Air: Last position.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine roughing-in for dampers and instruments installed in duct systems to verify actual locations of connections before installation.

C. Prepare written report, endorsed by Installer, listing conditions detrimental to performance.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 CONTROL-DAMPER APPLICATIONS

A. Select from damper types indicated to achieve performance requirements and characteristics indicated while subjected to full range of system operation encountered.

B. Rectangular Control-Damper Applications:

1. Exhaust Air: Rectangular dampers with aluminum flat blades; 0.05” w.g. maximum air pressure and 500 fpm maximum air velocity.
2. Outdoor Air: Rectangular dampers with aluminum airfoil blades; 0.05” w.g. maximum air pressure and 500 fpm maximum air velocity.
3. Return Air: Rectangular dampers with galvanized-steel flat blades; 0.05” w.g. maximum air pressure and 500 fpm maximum air velocity.
4. Supply Air: Rectangular dampers with aluminum flat blades; 0.05” w.g. maximum air pressure and 500 fpm maximum air velocity.

C. Rectangular Control Dampers with Insulated Blade Applications:

1. Exhaust Air: Rectangular dampers with insulated aluminum airfoil blades; 0.05” w.g. maximum air pressure and 500 fpm maximum air velocity.
2. Outdoor Air: Rectangular dampers with insulated aluminum airfoil blades and thermal break frames; 0.05” w.g. maximum air pressure and 500 fpm maximum

air velocity.
3. Return Air: Rectangular dampers with insulated aluminum airfoil blades; 0.05” w.g. maximum air pressure and 500 fpm maximum air velocity.
4. Supply Air: Rectangular dampers with insulated aluminum airfoil blades; 0.05” w.g. maximum air pressure and 500 fpm maximum air velocity.

D. Rectangular Control Dampers with Integral Airflow Applications:

1. Applications with Airflow Measurement: Rectangular dampers with aluminum airfoil blades and integral airflow measurement using pressure or thermal sensing.
2. Applications with Airflow Control: Rectangular dampers with aluminum airfoil blades and integral airflow control using pressure or thermal sensing.

E. Rectangular Industrial-Duty Control-Damper Applications:

1. Exhaust Air: Rectangular industrial-duty dampers with galvanized-steel airfoil blades; 0.05” w.g. maximum air pressure and 500 fpm maximum air velocity.
2. Outdoor Air: Rectangular industrial-duty dampers with stainless steel airfoil blades; 0.05” w.g. maximum air pressure and 500 fpm maximum air velocity.
3. Return Air: Rectangular industrial-duty dampers with galvanized-steel airfoil blades; 0.05” w.g. maximum air pressure and 500 fpm maximum air velocity.
4. Supply Air: Rectangular industrial-duty dampers with galvanized-steel airfoil blades; 0.05” w.g. maximum air pressure and 500 fpm maximum air velocity.

F. Round Control-Damper Applications:

1. Exhaust Air: Round galvanized steel dampers, sleeve ends; 0.05” w.g. maximum air pressure and 500 fpm maximum air velocity.
2. Outdoor Air: Round stainless steel dampers, sleeve ends; 0.05” w.g. maximum air pressure and 500 fpm maximum air velocity.
3. Return Air: Round galvanized-steel dampers, sleeve ends; 0.05” w.g. maximum air pressure and 500 fpm maximum air velocity.
4. Supply Air: Round galvanized-steel dampers, sleeve ends; 0.05” w.g. maximum air pressure and 500 fpm maximum air velocity.

3.3 INSTALLATION, GENERAL

A. Furnish and install products required to satisfy most stringent requirements indicated.

B. Properly support dampers and actuators, tubing, wiring, and conduit to comply with requirements indicated. Brace all products to prevent lateral movement and sway or a break in attachment when subjected to a seismic, wind, or other forces common to the application.

C. Provide ceiling, floor, roof, and wall openings , and sleeves required by installation. Before proceeding with drilling, punching, or cutting, check location first for concealed products that could potentially be damaged. Patch, flash, grout, seal, and refinish openings to match adjacent condition.

D. Seal penetrations made in fire-rated and acoustically rated assemblies.

E. Fastening Hardware:

1. Wrenches, pliers, or other tools that will cause injury to or mar surfaces of rods, nuts, and other parts are prohibited for assembling and tightening nuts.
2. Tighten bolts and nuts firmly and uniformly. Do not overstress threads by excessive force or by oversized wrenches.
3. Lubricate threads of bolts, nuts, and screws with graphite and oil before assembly.

F. Install products in locations that are accessible and that will permit calibration and maintenance from floor, equipment platforms, or catwalks. Where ladders are required for Owner's access, confirm unrestricted ladder placement is possible under occupied condition.

G. Corrosive Environments:

1. Use products that are suitable for environment to which they will be subjected.
2. If possible, avoid or limit use of materials in corrosive environments, including, but not limited to, the following:

    a. Laboratory exhaust airstreams.
    b. Process exhaust airstreams.

3. Use Type 316 stainless steel tubing and fittings when in contact with a corrosive environment.
4. When conduit is in contact with a corrosive environment, use Type 316 stainless steel conduit and fittings or conduit and fittings that are coated with a corrosive-resistant coating that is suitable for environment.
5. Where actuators are located in a corrosive environment and are not corrosive resistant from manufacturer, field install products in NEMA 250, Type 4X enclosure constructed of Type 316L stainless steel.

3.4 CONTROL DAMPERS

A. Install smooth transitions, not exceeding 15 degrees, to dampers larger or smaller than adjacent duct. Install transitions as close to damper as possible but at distance to avoid interference and impact to performance. Consult manufacturer for recommended clearance.

B. Clearance:

1. Locate dampers for easy access and provide separate support of dampers that cannot be handled by service personnel without hoisting mechanism.
2. Install dampers with at least 24 inches of clear space on sides of dampers requiring service access unless more space is recommended by manufacturer. Provide code required clearances as applicable.

C. Service Access:

1. Install dampers and actuators to be accessible for visual inspection and service.
2. Install access door(s) in duct or equipment located upstream of damper to allow service personnel to hand clean any portion of damper, linkage, and actuator. Comply with requirements in Section 233300 "Air Duct Accessories."

D. Install dampers straight and true, level in all planes, and square in all dimensions.

E. Install supplementary structural reinforcement for large multiple-section dampers if factory-furnished support alone cannot handle loading.

F. Attach field-installed actuator(s) to damper drive shaft.

G. For duct-mounted and equipment-mounted dampers installed outside of equipment, install a visible and accessible indication of damper position from outside.

3.5 IDENTIFICATION

A. Identify system components, wiring, cabling, and terminals. Each piece of wire, cable, and tubing is to have the same designation at each end for operators to determine continuity at points of connection. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

B. Install engraved phenolic nameplate with damper identification on damper and on face of ceiling where damper is concealed above ceiling.

3.6 ELECTRICAL CONNECTIONS

A. Install electrical power to field-mounted control devices requiring electrical power.

B. Connect wiring in accordance with Section 260519 "Low-Voltage Electrical Power Conductors and Cables" and Section 260523 "Control-Voltage Electrical Power Cables."

C. Ground equipment in accordance with Section 260526 "Grounding and Bonding for Electrical Systems."

D. Furnish and install raceways. Comply with requirements in Section 260533.13 "Conduits for Electrical Systems."

E. Furnish and install circuit breakers. Comply with requirements in Section 262816 "Enclosed Switches and Circuit Breakers."

F. Install electrical devices furnished by manufacturer, but not factory mounted, in accordance with NFPA 70 and NECA 1.

G. Install nameplate for each electrical connection, indicating electrical equipment designation and circuit number feeding connection.

1. Nameplate to be laminated acrylic or melamine plastic signs, as specified in Section 260553 "Identification for Electrical Systems."

2. Nameplate to be laminated acrylic or melamine plastic signs with a black background and engraved white letters at least **1/2 inch** high.

3.7 CONTROL CONNECTIONS

A. Pneumatic Control Connections: Connect pneumatic control valve actuators and accessories to pneumatic main and signal air. Comply with requirements in Section 230923 "Direct Digital Control (DDC) System for HVAC."

B. Install control signal wiring to field-mounted control devices.

C. Connect control signal wiring in accordance with Section 260523 "Control-Voltage Electrical Power Cables."

D. Furnish and install raceways. Comply with requirements in Section 260533.13 "Conduits for Electrical Systems."

3.8 CLEANING

A. Remove grease, mastic, adhesives, dust, dirt, stains, fingerprints, labels, and other foreign materials from exposed surfaces.

3.9 STARTUP

A. Control-Damper Checkout:

1. Check installed products before continuity tests, leak tests, and calibration.
2. Check dampers for proper location and accessibility.
3. Verify that control dampers are installed correctly for flow direction.
4. Verify that proper blade alignment, either parallel or opposed, has been provided.
5. Verify that damper frame attachment is properly secured and sealed.
6. Verify that damper actuator and damper linkage attachment are secure.
7. Verify that actuator wiring is complete, enclosed, and connected to correct power source.
8. Verify that damper blade travel is smooth and unobstructed throughout operating range.
9. Pneumatic Control Dampers:

    a. Check instrument tubing for proper isolation, fittings, slope, dirt legs, drains, material, and support.
    b. Verify air supply for each product is properly installed.
    c. Verify that pressure gauges are provided in each air line to damper actuator and positioner.

3.10 ADJUSTMENT, CALIBRATION, AND TESTING

A. Stroke and adjust control dampers following manufacturer's recommended procedure, from 100 percent open to 100 percent closed back to 100 percent open.

B. Stroke control dampers with pilot positioners. Adjust damper and positioner following manufacturer's recommended procedure, so damper is 100 percent closed, 50 percent closed, and 100 percent open at proper air pressure.

C. Check and document open and close cycle times for applications with a cycle time of less than 30 seconds.

D. For control dampers equipped with positive position indication, check feedback signal at multiple positions to confirm proper position indication.

END OF SECTION 23 09 23.12

SECTION 231123 - FACILITY NATURAL-GAS PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Steel pipe and fittings.
2. Mechanical couplings.
3. Piping specialties.
4. Manual gas shutoff valve.
5. Manual gas shutoff ball valve.
6. Automatic gas shutoff valve.
7. Pressure regulators.
8. Service meters.
9. Dielectric fittings.
10. Detectable warning tape.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of specified product.

B. Shop Drawings: Provide plans, piping layout and elevations, sections, and details for fabrication of pipe anchors, hangers, supports for multiple pipes, alignment guides, expansion joints and loops, and attachments of the same to building structure. Detail location of anchors, alignment guides, and expansion joints and loops.

1. Shop Drawing Scale: 1/4 inch per foot.
2. Detail mounting, supports, and valve arrangements for service-meter assembly and pressure regulator assembly.

1.3 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Plans and details, drawn to scale, on which natural-gas piping is shown and coordinated with other installations, using input from installers of the items involved.

B. Site Survey: Plans, drawn to scale, on which natural-gas piping is shown and coordinated with other services and utilities.

C. Seismic Qualification Data: Submit certification that vaporizer, air mixer, storage container supports, accessories, and components will withstand seismic forces defined in Section 230548 "Vibration and Seismic Controls for HVAC." Include the following:

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.

2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

D. Welding Certificates: For piping.

E. Field Quality Control Reports: For specified tests and inspections.

F. Qualification Statements: For professional engineer.

1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For automatic gas shutoff valves pressure regulators and service meters.

1.5 QUALITY ASSURANCE

A. Steel Support Welding Qualifications: Qualify procedures and personnel in accordance with AWS D1.1/D1.1M, "Structural Welding Code - Steel."

B. Pipe Welding Qualifications: Qualify procedures and operators in accordance with the ASME Boiler and Pressure Vessel Code.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Comply with NFPA 54 and the International Fuel Gas Code for natural-gas distribution system, including materials, installation, and testing.

B. Comply with requirements of authorities having jurisdiction.

C. Comply with requirements of utility company supplying natural-gas.

D. Minimum Operating-Pressure Ratings:

1. Piping and Valves: 100 psig minimum.
2. Service Regulators: 100 psig minimum.
3. Service Meter: 5 psig.

E. Natural-Gas System Pressure within Buildings:

1. Single Pressure: More than 0.5 psig but not more than 2 psig.
2. Two Pressure Ranges, Not More Than 2 psig (13.8 kPa): Primary pressure is more than **0.5 psig** but not more than **2 psig** and is reduced to secondary pressure of **0.5 psig** or less.
3. Two Pressure Ranges, Not More Than 5 psig (34.5 kPa): Primary pressure is

more than **2 psig** but not more than **5 psig** and is reduced to secondary pressure of more than **0.5 psig**, but not more than **2 psig**.

F. Delegated Design: Design restraints and anchors for LPG piping and equipment, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

G. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.2 PIPE, TUBES, AND FITTINGS

A. Steel Pipe and Fittings:

1. Steel Pipe: ASTM A53/A53M, black steel, Schedule 40, Type E or S, Grade B.
2. Malleable-Iron Threaded Fittings: ASME B16.3, Class 150, standard pattern.
3. Wrought-Steel Welding Fittings: ASTM A234/A234M for butt welding and socket welding.
4. Unions: ASME B16.39, Class 150, malleable iron with brass-to-iron seat, ground joint, and threaded ends.
5. Forged-Steel Flanges and Flanged Fittings: ASME B16.5, minimum Class 150, including bolts, nuts, and gaskets of the following material group, end connections, and facings:

    a. Material Group: 1.1.
    b. End Connections: Threaded or butt welding to match pipe.
    c. Lapped Face: Unacceptable for underground.
    d. Gasket Materials: ASME B16.20, metallic, flat, asbestos free, aluminum O-rings, and spiral-wound metal gaskets.
    e. Bolts and Nuts: ASME B18.2.1, carbon steel aboveground and stainless steel underground.

6. Protective Coating for Underground Piping: Factory-applied, three-layer coating of epoxy, adhesive, and PE.

    a. Joint Cover Kits: Epoxy paint, adhesive, and heat-shrink PE sleeves.

B. Aluminum Tubing, Piping, and Fittings:

1. Aluminum Tubing and Piping:

    a. Standards:

        1) ASTM B210/B210M.
        2) ASTM B241/B241M.

    b. Material: Aluminum Alloy 5456 is prohibited by NFPA 54.

2. Protective Coating: Factory-applied coating capable of resisting corrosion on

tubing in contact with masonry, plaster, insulation, water, detergents, and sewerage.

3. Flare Fittings: ASME B16.26 and SAE J513.

    a. Copper-alloy fittings.
    b. Metal-to-metal compression seal without gasket.
    c. Dryseal threads complying with ASME B1.20.3.

C. Copper Tubing and Fittings:

1. Drawn-Temper Copper Tube: ASTM B88, Type K and.
2. Annealed-Temper Copper Tube: ASTM B88, Type K and ASTM B88, Type L.
3. Coating: Factory-applied, extruded PE a minimum of **0.025 inch** thick. Continuously marked with size, specification information, manufacturing code, and footage every **2 ft.**.
4. Tin-Lined Copper Tube: ASTM B280, seamless, annealed, with interior tin-plated lining.
5. Copper Fittings: ASME B16.22, wrought copper, and streamlined pattern.
6. Bronze Flanges and Flanged Fittings: ASME B16.24, Class 150.

    a. Gasket Material: ASME B16.20, metallic, flat, asbestos free, aluminum O-rings, and spiral-wound metal gaskets.
    b. Bolts and Nuts: ASME B18.2.1, carbon steel or stainless steel.

7. Flare Fittings: Comply with ASME B16.26 and SAE J513.

    a. Copper fittings with long nuts.
    b. Metal-to-metal compression seal without gasket.
    c. Dryseal threads complying with ASME B1.20.3.

8. Protective Coating for Underground Tubing: Factory-applied, extruded PE a minimum of **0.022 inch** thick.

D. PE Pipe, Tubing, and Fittings:

1. PE Pipe and Tubing: ASTM D2513, SDR 11.
2. PE Fittings: ASTM D2683, socket-fusion type or ASTM D3261, butt-fusion type.
3. PE Transition Fittings: Factory-fabricated fittings with PE pipe complying with ASTM D2513, SDR 11; and steel pipe complying with ASTM A53/A53M, black steel, Schedule 40, Type E or S, Grade B.
4. Anodeless Service-Line Risers: Factory fabricated and leak tested.

    a. Underground Portion: PE pipe complying with ASTM D2513, SDR 11 inlet.
    b. Casing: Steel pipe complying with ASTM A53/A53M, Schedule 40, black steel, Type E or S, Grade B, with corrosion-protective coating covering. Vent casing aboveground.
    c. Aboveground Portion: PE transition fitting.
    d. Provide outlet threaded or flanged or suitable for welded connection.
    e. Provide tracer wire connection.
    f. Provide UV shield.

5. Transition Service-Line Risers: Factory fabricated and leak tested.

    a. Underground Portion: PE pipe complying with ASTM D2513, SDR 11 inlet connected to steel pipe complying with ASTM A53/A53M, Schedule 40, Type E or S, Grade B, with corrosion-protective coating for aboveground outlet.
    b. Provide outlet threaded or flanged or suitable for welded connection.
    c. Provide bridging sleeve over mechanical coupling.
    d. Provide factory-connected anode.
    e. Provide tracer wire connection.
    f. Provide UV shield.

2.3 MECHANICAL COUPLINGS

A. Mechanical Coupling - Steel:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

    a. Smith-Blair, a Xylem brand.

2. Source Limitation: Obtain couplings from single manufacturer.
3. Flanges and Tube: Steel with epoxy finish.
4. Seals: NBR.
5. Bolts, Washers, and Nuts: Steel bolts, washers, and nuts.
6. Factory-installed anode for steel-body couplings installed underground.
7. Suitable for joining plain-end PE pipe to PE pipe, steel pipe to PE pipe, or steel pipe to steel pipe.

2.4 JOINING MATERIALS

A. Joint Compound and Tape: Suitable for natural gas.

B. Welding Filler Metals: AWS D10.12/D10.12M.

C. Brazing Filler Metals: AWS A5.8/A5.8M alloy with melting point greater than **1000 deg F**. Brazing alloys containing more than 0.05 percent phosphorus are prohibited.

2.5 GAS VALVES

A. Manual Gas Shutoff Valve - Metallic:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

    a. A.Y. McDonald Mfg. Co.

2. Source Limitation: Obtain metallic manual gas shutoff valves from single manufacturer.
3. Description: Metallic ball valve or metallic plug valve of type indicated in schedules under Part 3.
4. Standards:

    a. CSA/ANSI Z21.15/CSA 9.1.
    b. ASME B16.33.
    c. ASME B16.44.

5. System Pressure Rating: More than 0.5 psig but not more than 2 psig.
6. Listed and labeled by an NRTL acceptable to authorities having jurisdiction.
7. Service Mark: Initials "WOG" permanently marked on valve body.
8. End Connections:

    a. Threaded Ends: ASME B1.20.1.
    b. Dryseal Threads on Flare Ends: ASME B1.20.3.
    c. Flanged Ends: ASME B16.5 for steel flanges.

9. Tamperproof locking feature.

B. Valve Box:

1. Cast-iron, two-section box.
2. Top section with cover with "GAS" lettering.
3. Bottom section with base to fit over valve and barrel a minimum of **5 inches** in diameter.
4. Adjustable cast-iron extensions of length required for depth of bury.
5. Include tee-handle, steel operating wrench with socket end fitting valve nut or flat head, and with stem of length required to operate valve.

C. Automatic Gas Shutoff Valve - Electrically Operated:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

    a. American Gas Safety, LLC.

2. Source Limitation: Obtain electrically operated automatic gas shutoff valves from single manufacturer.
3. Description: Electrically operated automatic valve, solenoid type, used in natural-gas piping for automatic shutoff of service when interlocked with a hazard-condition initiating device.
4. Standards:

    a. CSA/ANSI Z21.21/CSA 6.5.
    b. UL 429.
    c. FM Global approved.

5. Body: Brass or aluminum.

6. Seats and Disc: NBR.
7. Springs and Valve Trim: Stainless steel.
8. Coil: Continuous-duty, molded coil, replaceable.
9. Normally closed.
10. Visual position indicator.
11. Electrical Characteristics: 120 V ac, 60 Hz.

2.6 PRESSURE REGULATORS

A. Service Pressure Regulator:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

    a. Cavagna North America
    b. Dresser Utility Solutions
    c. Elster-American Meter
    d. Fairview Ltd.
    e. Fischer; Emerson Electric Co., Automation Solutions
    f. Marshall Excelsior Company
    g. Maxitrol Company
    h. RegO Products; a brand of Engineered Controls International, LLC
    i. Richards Industrials

2. Source Limitation: Obtain service pressure regulators from single manufacturer.
3. Standards:

    a. NFPA 54.
    b. ANSI Z21.80/CSA 6.22.

4. Single-port, self-contained regulator with orifice no larger than required at maximum pressure inlet, and no pressure sensing piping external to regulator.
5. Pressure regulator is to maintain discharge pressure setting downstream and is to not exceed 150 percent of design discharge pressure at shutoff.
6. Maximum Inlet Pressure: 100 psig.
7. Maximum Outlet Pressure: 2 psig.
8. End Connections: Threaded for regulators **NPS 2** and smaller; flanged for regulators **NPS 2-1/2** and larger.
9. Overpressure Protection Device: Factory mounted on pressure regulator.
10. Atmospheric Vent: Factory- or field-installed, stainless steel screen in opening if not connected to vent piping.

B. Line Pressure Regulator:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

    a. Cavagna North America

b. Dormont; A Watts Water Technologies Company
c. Dresser Utility Solutions
d. Elster-American Meter
e. Fischer; Emerson Electric Co., Automation Solutions
f. Marshall Excelsior Company
g. Maxitrol Company
h. RegO Products; a brand of Engineered Controls International, LLC

2. Source Limitation: Obtain line-pressure regulators from single manufacturer.
3. Standards:

a. NFPA 54.
b. CSA/ANSI Z21.80/CSA 6.22.

4. Single-port, self-contained regulator with orifice no larger than required at maximum pressure inlet, and no pressure sensing piping external to regulator.
5. Pressure regulator is to maintain discharge pressure setting downstream and is to not exceed 150 percent of design discharge pressure at shutoff.
6. Maximum Inlet Pressure: 5 psig.
7. Maximum Outlet Pressure: 2 psig.
8. End Connections: Threaded for regulators **NPS 2** and smaller; flanged for regulators **NPS 2-1/2** and larger.
9. Overpressure Protection Device: Factory mounted on pressure regulator.
10. Atmospheric Vent: Factory- or field-installed, stainless steel screen in opening if not connected to vent piping.

2.7 SERVICE METERS

A. Diaphragm-Type Service Meter:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Dresser Utility Solutions
b. Elster-American Meter

2. Source Limitation: Obtain diaphragm-type service meters from single manufacturer.
3. Standard: ANSI B109.1.
4. Case: Die-cast aluminum.
5. Connections: Steel threads.
6. Diaphragm: Synthetic fabric.
7. Diaphragm Support Bearings: Self-lubricating.
8. Compensation: Continuous temperature and pressure.
9. Meter Index: Cubic feet.
10. Meter Case and Index: Tamper resistant.
11. Remote meter reader compatible.
12. Maximum Inlet Pressure: 100 psig.
13. Pressure Loss: Maximum 0.5 inch wg.

14. Accuracy: Maximum plus or minus 1.0 percent.

2.8 DIELECTRIC FITTINGS

A. Assembly of copper alloy and ferrous materials with separating nonconductive insulating material. Include end connections compatible with pipes to be joined.

B. Dielectric Union:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

   a. A.Y. McDonald Mfg. Co.
   b. HART Industrial Unions, LLC
   c. Jomar Valve
   d. Matco-Norca
   e. WATTS; A Watts Water Technologies Company
   f. Zurn; Zurn Elkay

2. Standard: ASSE/IAMPO/ANSI/CAN 1079.
3. Pressure Rating: 125 psig minimum at 180 deg F.
4. End Connections: Solder-joint copper alloy and threaded ferrous.

2.9 Steel Pressure-Seal Fittings

A. Basis-of-Design Product: Subject to compliance with requirements, provide steel pressure-seal fitting or comparable product by one of the following:

1. Mueller Streamline Co.; a company of Mueller Industries

PART 3 - EXECUTION

3.1 INSTALLATION OF SERVICE METERS

A. Install service-meter assemblies aboveground, on concrete bases.

B. Install metal shutoff valves upstream from service regulators. Shutoff valves are not required at second regulators if two regulators are installed in series.

C. Install strainer on inlet of service-pressure regulator and meter set.

D. Install service regulators mounted outside with vent outlet horizontal or facing down. Install screen in vent outlet if not integral with service regulator.

E. Install metal shutoff valves upstream from service meters. Install dielectric fittings downstream from service meters.

F. Install service meters downstream from pressure regulators.

G. Install metal bollards to protect meter assemblies. Comply with requirements in Section 055000 "Metal Fabrications" for pipe bollards.

3.2 INSTALLATION OF PRESSURE REGULATORS

A. Ensure the gas supply is completely shut off at the main valve and that the line is fully depressurized.

B. Remove any shipping plugs from the inlet, outlet, and vent connections. Ensure the pipe interior and regulator are free of dirt, debris, and contaminants.

C. Apply pipe joint sealant or Teflon tape rated for gas use to the male threads of the pipe. Avoid getting sealant on the female threads or inside the regulator.

D. Mount the regulator in the correct orientation, aligning the flow arrow on the body with the direction of gas flow. The piping must be properly aligned and supported to avoid stressing the regulator.

E. If the pressure regulator is installed inside of a building, install a dedicated vent line directly from the regulator to the outdoors. The vent terminal must be insect resistant and rain resistant. The regulator should be at least **3 ft.** horizontally from any building opening below the vent opening, and positioned so that gas can disperse freely.

3.3 INSTALLATION OF GAS VALVES

A. Install manual gas shutoff valve for each gas appliance ahead of CSST, aluminum, or copper connector.

B. Install underground valves with valve boxes.

C. Install regulators and overpressure protection devices with maintenance access space adequate for servicing and testing.

D. Install earthquake valves aboveground outside buildings according to listing.

E. Install anode for metallic valves in underground PE piping.

F. Do not install valves in return-air plenums.

3.4 INSTALLATION OF HANGERS AND SUPPORTS

A. Comply with requirements for seismic-restraint devices specified in Section 230548 "Vibration and Seismic Controls for HVAC."

B. Comply with requirements in Section 230529 "Hangers and Supports for HVAC Piping and Equipment" for hangers, supports, and anchor devices.

C. Install hangers for steel piping, with maximum horizontal spacing and minimum rod diameters, to comply with MSS SP-58, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.

D. Install hangers for corrugated stainless steel tubing, with maximum horizontal spacing and minimum rod diameters, to comply with manufacturer's written instructions, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.

E. Support horizontal piping within 12 inches of each fitting.

F. Support vertical runs of steel piping to comply with MSS SP-58, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.

G. Support vertical runs of corrugated stainless steel tubing to comply with manufacturer's written instructions, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.

3.5 INSTALLATION OF LABELING AND IDENTIFICATION

A. Comply with requirements in Section 230553 "Identification for HVAC Piping and Equipment" for piping and valve identification.

B. Install detectable warning tape directly above gas piping, **12 inches** below finished grade, except **6 inches** below subgrade under pavements and slabs.

C. Label and identify gas piping and pressure outside a multitenant building by tenant.

3.6 FIELD QUALITY CONTROL

A. Tests and Inspections:

1. Comply with NFPA 54, and authorities having jurisdiction requirements for testing, inspection, and purging of natural-gas installation.
2. Natural-gas installation will be considered defective if it does not pass tests and inspections. Defective products are to be replaced. Retest installation after defective products have been replaced for code compliance.

B. Prepare test and inspection reports.

3.7 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain earthquake valves.

3.8 OUTDOOR NATURAL-GAS PIPING SCHEDULE

A. Underground Natural-Gas Piping: To be one of the following:

1. PE Pipe, Tubing and Fittings: Terminate service-line risers with tracer wire in an accessible location.
2. Steel Pipe: With wrought-steel welding fittings or mechanical couplings. Coat pipe and fittings with protective coating for steel piping.
3. Drawn-Temper Copper Tube: With copper fittings and brazed joints. Coat pipe and fittings with protective coating for copper tubing.
4. Annealed-Temper Copper Tube: With copper fittings and brazed joints. Coat pipe and fittings with protective coating for copper tubing.
5. Containment Conduit: In accordance with NFPA 54, and authorities having jurisdiction.

B. Aboveground Natural-Gas Piping: To be one of the following:

1. CSST and fittings.
2. Steel pipe with malleable-iron threaded fittings.
3. Steel pipe with wrought-steel welded fittings.
4. Drawn-Temper Copper Tube: With wrought-copper fittings and brazed joints. Coat pipe and fittings with protective coating for copper tubing.
5. Annealed-Temper Copper Tube: With wrought-copper fittings and brazed joints. Coat pipe and fittings with protective coating for copper tubing.

3.9 INDOOR NATURAL-GAS PIPING SCHEDULE FOR SYSTEM PRESSURES LESS THAN 0.5 PSIG (3.45 kPa)

A. Aboveground Branch Piping NPS 1 (DN 25) and Smaller: To be one of the following:

1. CSST and fittings.
2. Tin-Lined Copper Tube: With flared joints and fittings.
3. Annealed-Temper Copper Tube: With wrought-copper fittings and brazed joints.
4. Aluminum Tube: With flared fittings and joints.
5. Steel Pipe: With malleable-iron threaded fittings.

B. Aboveground Distribution Piping: To be one of the following:

1. Steel pipe with malleable-iron threaded fittings.
2. Steel pipe with wrought-steel welding fittings.
3. Drawn-Temper Copper Tube: With wrought-copper fittings and brazed joints.

C. Underground Below-Building Piping: To be one of the following:

1. Steel pipe with malleable-iron threaded fittings.
2. Steel pipe with wrought-steel welding fittings.
3. Containment Conduit: In accordance with NFPA 54, and authorities having jurisdiction.
4. Containment Conduit Vent Piping: In accordance with NFPA 54, and authorities having jurisdiction.

3.10 INDOOR NATURAL-GAS PIPING SCHEDULE FOR SYSTEM PRESSURES MORE THAN 0.5 PSIG (3.45 kPa) AND LESS THAN 5 PSIG (34.5 kPa)

A. Aboveground Branch Piping NPS 1 (DN 25) and Smaller: To be one of the following:

1. CSST and fittings.
2. Tin-Lined Copper Tube: With flared joints and fittings.
3. Annealed-Temper Copper Tube: With wrought-copper fittings and brazed joints.
4. Aluminum Tubing and Piping: With flared fittings and joints.
5. Steel Pipe: With malleable-iron threaded fittings.

B. Aboveground Distribution Piping: To be one of the following:

1. Steel pipe with malleable-iron threaded fittings.
2. Steel pipe with wrought-steel welding fittings.
3. Drawn-Temper Copper Tube: With wrought-copper fittings and brazed joints.

C. Underground Below-Building Piping: To be one of the following:

1. Steel pipe with malleable-iron threaded fittings.
2. Steel pipe with wrought-steel welding fittings.
3. Containment Conduit: In accordance with NFPA 54, and authorities having jurisdiction.
4. Containment Conduit Vent Piping: In accordance with NFPA 54, and authorities having jurisdiction.

3.11 INDOOR NATURAL-GAS PIPING SCHEDULE FOR SYSTEM PRESSURES MORE THAN 5 PSIG (34.5 kPa)

A. Aboveground Piping: Maximum operating pressure more than 5 psig.

B. Aboveground, Branch Piping:

1. Steel Pipe: With wrought-steel welding fittings.

C. Aboveground Distribution Piping: To be one of the following:

1. Steel Pipe: With wrought-steel welding fittings.
2. Drawn-Temper Copper Tube: With wrought-copper fittings and brazed joints.

D. Underground Below-Building Piping: To be one of the following:

1. Steel pipe with malleable-iron threaded fittings.
2. Steel pipe with wrought-steel welding fittings.
3. Containment Conduit: In accordance with NFPA 54, and authorities having jurisdiction.
4. Containment Conduit Vent Piping: In accordance with NFPA 54, and authorities having jurisdiction.

3.12 UNDERGROUND MANUAL GAS SHUTOFF VALVE SCHEDULE

A. Connections to Existing Gas Piping: Use valve and fitting assemblies made for tapping utility's gas mains and listed by an NRTL.

B. Underground:

1. Manual gas shutoff ball valve - PE.
2. Manual gas shutoff valve - metallic.

3.13 ABOVEGROUND MANUAL GAS SHUTOFF VALVE SCHEDULE

A. Aboveground Natural-Gas Piping: Manual gas shutoff valve - metallic.

END OF SECTION 23 11 23

SECTION 232300 - REFRIGERANT PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Copper tube and fittings.
2. Steel pipe and fittings.
3. Valves and specialties.
4. Refrigerants.

1.2 ACTION SUBMITTALS

A. Product Data: For each specified system and assembly, including components and accessories.

1. Submit data for each type of refrigerant piping, fitting, valve, piping specialty, and refrigerant.

B. Shop Drawings:

1. Show piping size and piping layout, including oil traps, double risers, specialties, and pipe and tube sizes to accommodate, at a minimum, equipment provided, elevation difference between compressor and evaporator, and length of piping to ensure proper operation and compliance with warranties of connected equipment.
2. Show interface and spatial relationships between piping and equipment.
3. Shop Drawing Scale: 1/4 inch equals 1 ft..

C. Delegated Design Submittals: For refrigerant piping design, including sizing and layout, oil traps, double risers, specialties, and pipe and tube sizes to accommodate, at a minimum, equipment provided, elevation difference between compressor and evaporator, and length of piping to ensure proper operation and compliance with warranties of connected equipment.

1.3 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Provide plans, piping schematics, and details, or Building Information Model (BIM), drawn to scale, showing the items described in this Section and coordinated with all building trades.

B. Welding Certificates: For each welder performing shop or field welding on Project.

C. Field Quality Control Reports: For each specified field quality-control test and inspection.

D. Delegated Design Engineer Qualification Statement: For refrigerant piping design.

1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For refrigerant valves and piping specialties.

1.5 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel in accordance with ASME Boiler and Pressure Vessel Code: Section IX, "Welding, Brazing, and Fusing Qualifications."

B. Delegated Design Engineer Qualifications: A professional engineer who is legally qualified to practice in Florida where Project is located and who is experienced in providing engineering services of the type indicated.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," for refrigerant piping size and layout, including oil traps, double risers, specialties, and pipe and tube sizes to accommodate, as a minimum, equipment provided, elevation difference between compressor and evaporator, and length of piping to ensure proper operation and compliance with warranties of connected equipment.

B. Comply with ASHRAE 15 and ASHRAE 34.

C. Comply with ASME B31.5.

D. Test Pressure for Refrigerant R-32:

1. Suction Tubing for Refrigeration and Air-Conditioning Applications Other than Heat Pumps: 300 psig.
2. Suction Tubing for Heat-Pump Applications: 535 psig.
3. Hot-Gas and Liquid Tubing: 535 psig.

E. Test Pressure for Refrigerant R-454B:

1. Suction Tubing for Refrigeration and Air-Conditioning Applications Other than Heat Pumps: 300 psig.
2. Suction Tubing for Heat-Pump Applications: 535 psig.
3. Hot-Gas and Liquid Tubing: 535 psig.

2.2 COPPER TUBE AND FITTINGS

A. Copper Tube, for Refrigerant Piping: ASTM B280, Type ACR,.

B. Wrought-Copper Fittings, Brazed Joint: ASME B16.50.

C. Wrought-Copper Unions: ASME B16.22.

D. Brazing Filler Metals: AWS A5.8M/A5.8.

E. Flexible Connectors:

1. Body: Tin-bronze bellows with woven, flexible, tinned-bronze-wire-reinforced protective jacket.
2. End Connections: Socket ends.
3. Offset Performance: Capable of minimum **3/4-inch** misalignment in minimum **7-inch-** long assembly.
4. Working Pressure Rating: Factory test at minimum 500 psig.
5. Maximum Operating Temperature: 250 deg F.

F. Copper-Tube, Pressure-Seal-Joint Fittings for Refrigerant Piping:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

    a. Conex Bänninger; a part of IBP Group LLC
    b. Mueller Streamline Co.; a company of Mueller Industries
    c. Parker Hannifin; Sporlan Division
    d. RLS LLC

2. Standard: UL 207; certified by UL for field installation. Certification as a UL-recognized component alone is unacceptable.
3. Housing: Copper.
4. O-Rings: HNBR compatible with specific refrigerant.
5. Tools: Manufacturer's approved special tools.
6. Minimum Rated Pressure: 700 psig.

2.3 VALVES AND SPECIALTIES

A. Service Valves:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

    a. Danfoss, Inc.
    b. Henry Technologies Inc.; The Henry Group
    c. JB Industries
    d. Parker (Parker Hannifin)

e. RectorSeal HVAC; a CSW Industrials Company
f. Refrigeration Sales, Inc.

2. Body: Forged brass with brass cap, including key end to remove core.
3. Core: Removable ball-type check valve with stainless steel spring.
4. Seat: Polytetrafluoroethylene.
5. End Connections: Copper spring.
6. Working Pressure Rating: 500 psig.
7. Maximum Operating Temperature: 275 deg F.

B. Thermostatic Expansion Valves: Comply with **AHRI 750 I-P**.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Danfoss, Inc.
b. Henry Technologies Inc.; The Henry Group
c. Parker Hannifin; Sporlan Division

2. Body, Bonnet, and Seal Cap: Forged brass or steel.
3. Diaphragm, Piston, Closing Spring, and Seat Insert: Stainless steel.
4. Packing and Gaskets: Non-asbestos.
5. Capillary and Bulb: Copper tubing filled with refrigerant charge.
6. Suction Temperature: 40 deg F.
7. Superheat: Adjustable.
8. Design: Reverse-flow option (for heat-pump applications).
9. End Connections: Socket, flare, or threaded union.
10. Working Pressure Rating: 700 psig.

C. Moisture/Liquid Indicators:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Danfoss, Inc.
b. Henry Technologies Inc.; The Henry Group
c. Parker (Parker Hannifin)
d. RLS LLC

2. Body: Forged brass.
3. Window: Replaceable, clear, fused glass window with indicating element protected by filter screen.
4. Indicator: Color-coded to show moisture content in parts per million (ppm).
5. Minimum Moisture Indicator Sensitivity: Indicate moisture above 60 ppm.
6. End Connections: Socket or flare.
7. Working Pressure Rating: 500 psig.
8. Maximum Operating Temperature: 240 deg F.

2.4 REFRIGERANTS

A. R-32, ASHRAE 34: Difluoromethane.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Arkema Inc.
b. Honeywell International Inc.
c. Mexichem Fluor, Inc. (Koura)
d. The Chemours Company

B. R-454B, ASHRAE 34: R (68.9 percent by mass) and R-1234yf (31.1 percent by mass).

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Arkema Inc.
b. Honeywell International Inc.
c. Mexichem Fluor, Inc. (Koura)
d. The Chemours Company

PART 3 - EXECUTION

3.1 PIPING APPLICATION SCHEDULES

A. Refrigerant: R-454B R-32.

B. Suction, Hot-Gas, and Liquid Tubing for Conventional Air-Conditioning (Cooling-Only) Applications, NPS 1-1/2 (DN 40) and Smaller, Annealed-Temper: Copper, Type ACR, annealed-temper tubing and ACR copper fittings with pressure-seal joints.

C. Suction, Hot-Gas, and Liquid Tubing for Conventional Air-Conditioning (Cooling-Only) Applications, NPS 4 (DN 100) and Smaller, Drawn-Temper: Copper, Type ACR drawn-temper tubing and wrought-copper fittings with brazed joints.

D. Suction, Hot-Gas, and Liquid Tubing for Conventional Air-Conditioning (Cooling-Only) Applications, NPS 2 to NPS 4 (DN 50 to DN 100), Drawn-Temper: Copper, Type ACR drawn-temper tubing and wrought-copper fittings with brazed joints.

E. Safety-Relief-Valve Discharge Tubing for Conventional Air-Conditioning (Cooling-Only) Applications, Copper: Type ACR, tubing and wrought-copper fittings with brazed joints.

F. Safety-Relief-Valve Discharge Piping for Conventional Air-Conditioning (Cooling-Only) Applications, Steel: Schedule 40, black steel and wrought-steel fittings with welded joints.

G. Suction, Hot-Gas, and Liquid Tubing for Heat-Pump Applications, NPS 1-1/2 (DN 40)

and Smaller, Annealed-Temper: Copper, Type ACR, annealed-temper tubing and ACR copper fittings with pressure-seal joints.

H. Suction, Hot-Gas, and Liquid Tubing for Heat-Pump Applications, NPS 4 (DN 100) and Smaller, Drawn-Temper: Copper, Type ACR, drawn-temper tubing and wrought-copper fittings with brazed joints.

I. Suction, Hot-Gas, and Liquid Tubing for Heat-Pump Applications, NPS 2 to NPS 4 (DN 50 to DN 100), Drawn-Temper: Copper, Type ACR, drawn-temper tubing and wrought-copper fittings with brazed joints.

J. Safety-Relief-Valve Discharge Tubing for Heat-Pump Applications, Copper: Type ACR, tubing and wrought-copper fittings with brazed joints.

K. Safety-Relief-Valve Discharge Piping for Heat-Pump Applications, Steel: Schedule 40, black steel and wrought-steel fittings with welded joints.

L. Refrigerant Tubing for Variable Refrigerant Flow System Applications:

1. Copper Tube: ASTM B280, Type ACR.
2. Wrought-Copper Fittings, Brazed Joints: ASME B16.50.
3. Brazing Filler Metals: AWS A5.8/A5.8M.

M. Safety-Relief-Valve Discharge Tubing for VRF Applications, Copper: Type ACR, tubing and wrought-copper fittings with brazed joints.

N. Safety-Relief-Valve Discharge Piping for VRF Applications, Steel: Schedule 40, black steel and wrought-steel fittings with welded joints.

3.2 INSTALLATION OF VALVES AND SPECIALTIES

A. Install diaphragm packless valves in suction and discharge lines of compressor.

B. Install service valves for gauge taps at inlet and outlet of hot-gas bypass valves and strainers if they are not an integral part of valves and strainers.

C. Install a check valve at the compressor discharge and a liquid accumulator at the compressor suction connection.

D. Except as otherwise indicated, install diaphragm packless valves on inlet and outlet side of filter dryers.

E. Install a full-size, three-valve bypass around filter dryers.

F. Install solenoid valves upstream from each expansion valve and hot-gas bypass valve. Install solenoid valves in horizontal lines with coil at top.

G. Install thermostatic expansion valves as close as possible to distributors on evaporators.

1. Install valve so diaphragm case is warmer than bulb.

2. Secure bulb to clean, straight, horizontal section of suction line using two bulb straps. Do not mount bulb in a trap or at bottom of the line.
3. If external equalizer lines are required, make connection where it will reflect suction-line pressure at bulb location.

H. Install safety-relief valves where required by ASME Boiler and Pressure Vessel Code. Pipe safety-relief-valve discharge line to outside in accordance with ASHRAE 15.

I. Install moisture/liquid indicators in liquid line at the inlet of the thermostatic expansion valve or at the inlet of the evaporator coil capillary tube.

J. Strainers: Install strainers upstream from and adjacent to the following unless they are furnished as an integral assembly for the device being protected:

1. Solenoid valves.
2. Thermostatic expansion valves.
3. Hot-gas bypass valves.
4. Compressor.

K. Install filter dryers in liquid line between compressor and thermostatic expansion valve , and in the suction line at the compressor.

L. Install receivers sized to accommodate pump-down charge.

M. Install flexible connectors at compressors.

N. Provide refrigerant locking caps on refrigerant charging ports that are located outdoors unless otherwise protected from unauthorized access by a means acceptable to authority having jurisdiction.

3.3 INSTALLATION OF REFRIGERANT PIPING, GENERAL

A. Requirements in this article apply to all piping materials, except where more specific requirements are specified in various pipe and fittings installation articles below.

B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems; indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Shop Drawings.

C. Install refrigerant piping in accordance with ASHRAE 15.

D. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.

E. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

F. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

G. Install piping adjacent to machines to allow service and maintenance.

H. Install piping free of sags and bends.

I. Install fittings for changes in direction and branch connections.

J. Select system components with pressure rating equal to or greater than system operating pressure.

K. See Section 230923 "Direct Digital Control (DDC) System for HVAC" and Section 230993.11 "Sequence of Operations for HVAC DDC" for solenoid valve controllers, control wiring, and sequence of operation.

L. Install piping as short and direct as possible, with a minimum number of joints, elbows, and fittings.

M. Arrange piping to allow inspection and service of refrigeration equipment. Install valves and specialties in accessible locations to allow for service and inspection. Install access doors or panels as specified in Section 083113 "Access Doors and Frames" if valves or equipment requiring maintenance is concealed behind finished surfaces.

N. Install refrigerant piping in protective conduit where installed belowground.

O. Install refrigerant piping in rigid or flexible conduit in locations where exposed to potential mechanical injury.

P. Slope refrigerant piping as follows:

1. Install horizontal hot-gas discharge piping with a uniform slope downward away from compressor.
2. Install horizontal suction lines with a uniform slope downward to compressor.
3. Install traps and double risers to entrain oil in vertical runs.
4. Liquid lines may be installed level.

Q. Install piping with adequate clearance between pipe and adjacent walls and hangers or between pipes for insulation installation.

R. Identify refrigerant piping and valves in accordance with Section 230553 "Identification for HVAC Piping and Equipment."

S. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 230500 "Common Work Results for HVAC."

T. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 230500 "Common Work Results for HVAC."

U. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 230500 "Common Work Results for HVAC."

3.4 INSTALLATION OF COPPER TUBE AND FITTINGS

A. When brazing copper tubing, remove solenoid-valve coils and sight glasses; also remove valve stems, seats, packing, and accessible internal parts of refrigerant specialties. Do not apply heat near expansion-valve bulb.

B. Joint Construction:

1. Ream ends of tubes and remove burrs.
2. Remove scale, slag, dirt, and debris from inside and outside of tube and fittings before assembly.
3. Brazed Joints: Construct joints in accordance with AWS BRH, "Brazing Handbook," Ch. 35, "Pipe and Tubing."

    a. Use Type BCuP (copper-phosphorus) alloy for joining copper socket fittings with copper pipe.
    b. Use Type BAg (cadmium-free silver) alloy for joining copper with bronze or steel.

4. Copper-tube, Pressure-Seal-Joint Fittings: Construct joints in accordance with manufacturer's written instructions.

3.5 INSTALLATION OF STEEL PIPE AND FITTINGS

A. Pre-Installation Cleaning: Before installation of steel refrigerant piping, clean pipe and fittings using the following procedures:

1. Shot blast the interior of piping.
2. Remove coarse particles of dirt and dust by drawing a clean, lintless cloth through tubing by means of a wire or electrician's tape.
3. Draw a clean, lintless cloth saturated with trichloroethylene through the tube or pipe. Continue this procedure until cloth is not discolored by dirt.
4. Draw a clean, lintless cloth, saturated with compressor oil, squeezed dry, through the tube or pipe to remove remaining lint. Inspect tube or pipe visually for remaining dirt and lint.
5. Finally, draw a clean, dry, lintless cloth through the tube or pipe.
6. Safety-relief-valve discharge piping is not required to be cleaned but is required to be open to allow unrestricted flow.

B. Joint Construction:

1. Ream ends of pipes and remove burrs. Bevel plain ends of steel pipe.
2. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
3. Fill pipe and fittings with an inert gas (nitrogen or carbon dioxide), during brazing or welding, to prevent scale formation.
4. Threaded Joints: Thread steel pipe with tapered pipe threads in accordance with ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and to restore full ID. Join pipe fittings and valves as follows:

a. Apply appropriate tape or thread compound to external pipe threads unless dry-seal threading is specified.
b. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.

5. Steel pipe can be threaded, but threaded joints must be seal brazed or seal welded.
6. Welded Joints: Construct joints in accordance with AWS D10.12M/D10.12.
7. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.

3.6 INSTALLATION OF HANGERS AND SUPPORTS

A. Comply with requirements for seismic restraints in Section 230548 "Vibration and Seismic Controls for HVAC."

B. Comply with Section 230529 "Hangers and Supports for HVAC Piping and Equipment" for hangers, supports, and anchor devices.

C. Piping Attachments: Install the following pipe attachments:

1. Adjustable steel clevis hangers for individual horizontal runs less than **20 ft.** long.
2. Roller hangers and spring hangers for individual horizontal runs **20 ft.** or longer.
3. Pipe Roller: MSS SP-58, Type 44 for multiple horizontal piping **20 ft.** or longer, supported on a trapeze.
4. Spring hangers to support vertical runs.
5. Copper-clad hangers and supports for hangers and supports in direct contact with copper tube.

D. Install hangers for metal tubing and piping, with maximum horizontal spacing and minimum rod diameters, to comply with MSS SP-58, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.

E. Support horizontal piping within 12 inches of each fitting.

F. Support vertical runs of metal tubing and piping to comply with MSS SP-58, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.

3.7 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Perform tests and inspections.

C. Tests and Inspections:

1. Comply with ASME B31.5, Chapter VI.

2. Test refrigerant piping, specialties, and receivers. Isolate compressor, condenser, evaporator, and safety devices from test pressure if they are not rated above the test pressure.
3. Test high- and low-pressure side piping of each system separately at not less than the pressures indicated in "Performance Requirements" Article.

    a. Fill system with nitrogen to the required test pressure.
    b. System must maintain test pressure at the manifold gauge throughout duration of test.
    c. Test joints and fittings with electronic leak detector or by brushing a small amount of soap and glycerin solution over joints.
    d. Remake leaking joints using new materials, and retest until satisfactory results are achieved.

4. Prepare test and inspection reports.

3.8 SYSTEM CHARGING

A. Procedures: Charge system using the following procedures:

1. Install core in filter dryers after leak test but before evacuation.
2. Evacuate entire refrigerant system with a vacuum pump to **500 micrometers**. If vacuum holds for 12 hours, system is ready for charging.
3. Break vacuum with refrigerant gas, allowing pressure to build up to **2 psig**.
4. Charge system with a new filter-dryer core in charging line.

END OF SECTION 23 23 00

SECTION 23 31 13 - METAL DUCTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Rectangular ducts and fittings, factory fabricated - single wall.
2. Rectangular ducts and fittings, shop fabricated - single wall.
3. Rectangular ducts and fittings, factory fabricated - double wall.
4. Rectangular ducts and fittings, shop fabricated - double wall.
5. Round ducts and fittings, factory fabricated - single wall.
6. Round ducts and fittings, factory fabricated - double wall.
7. Sheet metal materials.
8. Sealants and gaskets.
9. Hangers and supports.
10. Strut support system for ductwork - metal, cable type.

B. Related Requirements:

1. Section 018123 "Facility Seismic and Wind Criteria" specifies basis-of-design seismic and wind criteria for nonstructural components.
2. Section 230130.52 "Existing HVAC Air Distribution System Cleaning" for cleaning of existing HVAC air-distribution equipment, ducts, plenums, and system components.
3. Section 230548 "Vibration and Seismic Controls for HVAC" for seismic restraint devices and installation.
4. Section 230548.13 "Vibration Controls for HVAC" for vibration-isolated ductwork and hangers.
5. Section 230593 "Testing, Adjusting, and Balancing for HVAC" for testing, adjusting, and balancing requirements for metal ducts.
6. Section 230800 "Commissioning of HVAC" for HVAC commissioning procedures.
7. Section 233116 "Nonmetal Ducts" for fibrous-glass ducts, thermoset fiber-reinforced plastic ducts, thermoplastic ducts, PVC ducts, concrete ducts, and factory-fabricated outdoor insulated phenolic duct systems.
8. Section 233119.13 "Shop-Fabricated HVAC Casings" for field-fabricated casings for mechanical equipment.
9. Section 233119.16 "Manufactured HVAC Casings" for factory-fabricated casings for mechanical equipment.
10. Section 233300 "Air Duct Accessories" for dampers, sound-control devices, duct-mounted access doors and panels, turning vanes, and flexible ducts.

1.2 DEFINITIONS

A. OSHPD: Office of Statewide Health Planning and Development (State of California). (Now part of the Department of Health Care Access and Information for the State of

California.)

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings:

1. Fabrication, assembly, and installation, including plans, elevations, sections, components, and attachments to other work.
2. Factory- and shop-fabricated ducts and fittings.
3. Duct layout indicating sizes, configuration, liner material, and static-pressure and leakage classes.
4. Elevation of top and bottom of ducts.
5. Dimensions of main duct runs from building grid lines.
6. Fittings.
7. Reinforcement and spacing.
8. Seam and joint construction.
9. Penetrations through fire-rated and other partitions.
10. Equipment installation based on equipment being used on Project.
11. Locations for duct accessories, including dampers, turning vanes, and access doors and panels.
12. Hangers and supports, including methods for duct and building attachment and vibration isolation.
13. Duct Liner: Including attenuation and U-value factors.
14. Sealants and Gaskets: Including materials and code compliance.

C. Delegated Design Submittals:

1. Ductwork:

a. Sheet metal thicknesses.
b. Joint and seam construction and sealing.
c. Reinforcement details and spacing.
d. Materials, fabrication, assembly, and spacing of hangers and supports.

2. Design Calculations: Calculations for selecting hangers and supports .

D. Sustainable Design Submittals:

1.4 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: A single set of plans or BIM model, drawn to scale, showing the items described in this Section, and coordinated with all building trades.

B. Welding certificates.

C. Field quality control reports.

1.5 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel in accordance with the following:

1. AWS D1.1/D1.1M, "Structural Welding Code - Steel," for hangers and supports.
2. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum," for aluminum supports.
3. AWS D9.1/D9.1M, "Sheet Metal Welding Code," for duct joint and seam welding.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Delegated Duct Design: Duct construction, including sheet metal thicknesses, seam and joint construction, reinforcements, and hangers and supports, to comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" and with performance requirements and design criteria indicated in "Duct Application Schedule" Article.

B. Wind-Restraint Performance: See Section 018123 "Facility Seismic and Wind Criteria" and Section 230548 "Vibration and Seismic Controls for HVAC" for building classification criteria.

C. Airstream Surfaces: Surfaces in contact with airstream comply with requirements in ASHRAE 62.1.

D. ASHRAE 62.1 Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment," and Section 7 - "Construction and System Startup."

E. ASHRAE/IES 90.1 Compliance: Applicable requirements in ASHRAE/IES 90.1, Section 6.4.4 - "HVAC System Construction and Insulation."

F. Duct Dimensions: Unless specifically indicated otherwise on the Drawings, all duct dimensions indicated on the Drawings are inside clear dimensions and do not include insulation or duct wall thickness.

2.2 RECTANGULAR DUCTS AND FITTINGS

A. Rectangular Ducts and Fittings, Factory Fabricated - Single Wall:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. McGill AirFlow LLC
b. MKT Metal Manufacturing
c. SHAPE Manufacturing Inc.
d. Sheet Metal Connectors, Inc.

2. Source Limitations: Obtain single-wall, factory-fabricated rectangular ducts and fittings from single manufacturer.
3. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" based on static-pressure ratings indicated on Drawings.

    a. Material, Indoor Ductwork: See Part 3 "Duct Application Schedule" Article for indoor duct materials applications.
    b. Material, Ductwork Exposed to Weather: For ducts exposed to weather, construct of Type 304 stainless steel indicated by manufacturer in writing to be suitable for outdoor installation.
    c. For hood ductwork, construct ducts of Type 304 stainless steel indicated by manufacturer in writing to be suitable for the application.

4. Transverse Joints: Fabricate joints in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-1, "Rectangular Duct/Transverse Joints," for static pressure, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

    a. For ducts with longest side less than **36 inches**, select joint types in accordance with Figure 2-1.
    b. For ducts with longest side **36 inches** or greater, use flange joint connector Type T-22, T-24, T-24A, T-25a, or T-25b. Factory-fabricated flanged duct connection system may be used if submitted and approved by engineer of record.
    c. Welded Transverse Joints:

        1) Provide all welded transverse joints for hood ductwork.
        2) See the Drawings for specific systems or applications.

5. Longitudinal Seams: Select seam types and fabricate in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-2, "Rectangular Duct/Longitudinal Seams," for static pressure, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

    a. Welded Longitudinal Seams:

        1) Provide all welded longitudinal seams for hood ductwork.
        2) See Drawings for specific systems or applications.

6. Elbows, Transitions, Offsets, Branch Connections, and Other Duct Construction: Select types and fabricate in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Ch. 4, "Fittings and Other Construction," for static pressure, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

B. Rectangular Ducts and Fittings, Shop Fabricated - Single Wall:

1. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" based on static pressure indicated on Drawings.

    a. Material, Indoor Ductwork: See Part 3 "Duct Application Schedule" Article for indoor duct material applications.
    b. Material, Ductwork Exposed to Weather: For ducts exposed to weather, construct with joints and other details in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," suitable for outdoor use.

2. Transverse Joints: Fabricate joints in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-1, "Rectangular Duct Transverse/Transverse Joints," for static pressure, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

    a. Welded Transverse Joints:

        1) Provide all welded transverse joints for hood ductwork.
        2) See Drawings for specific systems or applications.

3. Longitudinal Seams: Select seam types and fabricate in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-2, "Rectangular Duct/Longitudinal Seams," for static pressure, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

    a. Welded Longitudinal Seams:

        1) Provide all welded longitudinal seams for hood ductwork.
        2) See the Drawings for specific systems or applications.

4. Elbows, Transitions, Offsets, Branch Connections, and Other Duct Construction: Select types and fabricate in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Ch. 4, "Fittings and Other Construction," for static pressure, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

C. Rectangular Ducts and Fittings, Factory Fabricated - Double Wall:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

    a. McGill AirFlow LLC
    b. MKT Metal Manufacturing
    c. SHAPE Manufacturing Inc.
    d. Sheet Metal Connectors, Inc.

2. Source Limitations: Obtain double-wall, factory-fabricated rectangular ducts and fittings from single manufacturer.
3. Rectangular Ducts: Fabricate ducts with indicated dimensions for clear internal dimensions of the inner duct.
4. Outer Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" based on static pressure indicated on the Drawings.

    a. Material, Indoor Ductwork: See Part 3 "Duct Application Schedule" Article for indoor duct material applications.
    b. Material, Ductwork Exposed to Weather: For ducts exposed to weather, construct outer duct of Type 304 stainless steel indicated by manufacturer in writing to be suitable for outdoor installation.
    c. For hood ductwork, construct ducts of Type 304 stainless steel indicated by manufacturer in writing to be suitable for the application.

5. Transverse Joints: Select joint types and fabricate in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-1, "Rectangular Duct/Transverse Joints," for static pressure, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

    a. For ducts with longest side less than **36 inches**, select joint types in accordance with Figure 2-1.
    b. For ducts with longest side **36 inches** or greater, use flange joint connector Type T-22, T-24, T-24A, T-25a, or T-25b. Factory-fabricated flanged duct connection system may be used if submitted and approved by engineer of record.
    c. Welded Transverse Joints:

        1) Provide all welded transverse joints for hood ductwork.
        2) See Drawings for specific systems or applications.

6. Longitudinal Seams: Select seam types and fabricate in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-2, "Rectangular Duct/Longitudinal Seams," for static pressure, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

    a. Welded Longitudinal Seams:

        1) Provide all welded longitudinal seams for all hood ductwork.
        2) See Drawings for specific systems or applications.

7. Interstitial Insulation, Fibrous Glass: Duct liner complying with ASTM C1071, NFPA 90A, or NFPA 90B; and with NAIMA AH124.

    a. Maximum Thermal Conductivity: 0.1667Insert conductivity at **75 deg F** mean temperature.
    b. Install spacers that position the inner duct at uniform distance from outer duct without compressing insulation.
    c. Coat insulation with antimicrobial coating.

d. Cover insulation with polyester film complying with UL 181, Class 1.

8. Interstitial Insulation, Flexible Elastomeric: Duct liner complying with ASTM C534/C534M, Type II for sheet materials, and with NFPA 90A or NFPA 90B.

a. Maximum Thermal Conductivity: 0.1667 at **75 deg F** mean temperature.

9. Inner Duct: Minimum **24-gauge** solid galvanized sheet steel.

D. Rectangular Ducts and Fittings, Shop Fabricated - Double Wall:

1. Rectangular Ducts: Fabricate ducts with indicated dimensions for clear internal dimensions of the inner duct.
2. Outer Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" based on static pressure indicated on the Drawings.

a. Material, Indoor Ductwork: See Part 3 "Duct Application Schedule" Article for indoor duct material applications.
b. Material, Ductwork Exposed to Weather: For ducts exposed to weather, construct outer duct of Type 304 stainless steel indicated by manufacturer in writing to be suitable for outdoor installation.
c. For hood ductwork, construct ducts of Type 304 stainless steel indicated by manufacturer in writing to be suitable for the application.

3. Transverse Joints: Select joint types and fabricate in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-1, "Rectangular Duct/Transverse Joints" for static pressure, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

a. Welded Transverse Joints:

1) Provide all welded transverse joints for hood ductwork.
2) See Drawings for specific systems or applications.

4. Longitudinal Seams: Select seam types and fabricate in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-2, "Rectangular Duct/Longitudinal Seams," for static pressure, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

a. Welded Longitudinal Seams:

1) Provide all welded longitudinal seams for hood ductwork.
2) See Drawings for specific systems or applications.

5. Interstitial Insulation, Fibrous Glass: Duct liner complying with ASTM C1071, NFPA 90A, or NFPA 90B; and with NAIMA AH124.

a. Maximum Thermal Conductivity: 0.1667 at **75 deg F** mean temperature.
b. Install spacers that position the inner duct at uniform distance from outer

duct without compressing insulation.
c. Coat insulation with antimicrobial coating.
d. Cover insulation with polyester film complying with UL 181, Class 1.

6. Interstitial Insulation, Flexible Elastomeric: Duct liner complying with ASTM C534/C534M, Type II for sheet materials, and with NFPA 90A or NFPA 90B.

   a. Maximum Thermal Conductivity: 0.1667 at **75 deg F** mean temperature.

7. Inner Duct: Minimum **24-gauge**.

   a. Perforated Galvanized Sheet Steel: 3/32-inch- diameter perforations, with overall open area of 23 percent.
   b. Solid galvanized sheet steel.

2.3 ROUND DUCTS AND FITTINGS

A. Round Ducts and Fittings, Factory Fabricated - Single Wall:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

   a. Elgen Manufacturing
   b. GreenSeam
   c. Linx Industries; a DMI company (formerly Lindab)
   d. McGill AirFlow LLC
   e. MKT Metal Manufacturing
   f. Nordfab Ducting
   g. SEMCO, LLC; part of FlaktGroup
   h. Set Duct Manufacturing
   i. SHAPE Manufacturing Inc.
   j. Sheet Metal Connectors, Inc.
   k. Spiral Manufacturing Co., Inc.

2. Source Limitations: Obtain single-wall, factory-fabricated round ducts and fittings from single manufacturer.
3. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Ch. 3, "Round, Oval, and Flexible Duct," based on static pressure indicated in "Duct Application Schedule" Article.

   a. Material, Indoor Ductwork: See Part 3 "Duct Application Schedule" Article for indoor duct material applications.
   b. Material, Ductwork Exposed to Weather: For ducts exposed to weather, construct of Type 304 stainless steel indicated by manufacturer in writing to be suitable for outdoor installation.

4. Transverse Joints: Select joint types and fabricate in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-1, "Round Duct Transverse Joints," for static pressure, applicable sealing requirements,

materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

a. Provide flanged joints for transverse joints in ducts larger than 60 inches in diameter.

5. Longitudinal Seams: Select seam types and fabricate in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-2, "Round Duct Longitudinal Seams," for static pressure, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

a. Fabricate round ducts larger than 90 inches in diameter with butt-welded longitudinal seams.

6. Tees and Laterals: Select types and fabricate in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-5, "90 Degree Tees and Laterals," and Figure 3-6, "Conical Tees," for static pressure, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

B. Round Ducts and Fittings, Factory Fabricated - Double Wall:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Linx Industries; a DMI company (formerly Lindab)
b. McGill AirFlow LLC
c. MKT Metal Manufacturing
d. SEMCO, LLC; part of FlaktGroup
e. Set Duct Manufacturing
f. SHAPE Manufacturing Inc.
g. Sheet Metal Connectors, Inc.

2. Source Limitations: Obtain double-wall, round ducts and fittings from single manufacturer.
3. Outer Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Ch. 3, "Round, Oval, and Flexible Duct," based on static pressure indicated on the Drawings.

a. Material, Indoor Ductwork: Construct ducts of galvanized sheet steel.
b. Material, Ductwork Exposed to Weather: For ducts exposed to weather, construct outer duct of Type 304 stainless steel indicated by manufacturer in writing to be suitable for outdoor installation.
c. For hood ductwork, construct ducts of Type 304 stainless steel indicated by manufacturer in writing to be suitable for the application.

4. Transverse Joints: Select joint types and fabricate in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-1, "Round

Duct Transverse Joints," for static pressure, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

a. Provide flanged joints for transverse joints in ducts larger than 60 inches in diameter.

5. Longitudinal Seams: Select seam types and fabricate in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-2, "Round Duct Longitudinal Seams," for static pressure, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

a. Fabricate round ducts larger than 90 inches in diameter with butt-welded longitudinal seams.

6. Tees and Laterals: Select types and fabricate in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-5, "90 Degree Tees and Laterals," and Figure 3-6, "Conical Tees," for static pressure, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
7. Inner Duct: Minimum **24-gauge**.

a. Perforated Galvanized Sheet Steel: 3/32-inch- diameter perforations, with overall open area of 23 percent.
b. Solid galvanized sheet steel.

8. Interstitial Insulation, Fibrous Glass: Duct liner complying with ASTM C1071, NFPA 90A, or NFPA 90B; and with NAIMA AH124.

a. Maximum Thermal Conductivity: 0.1667 Btu x in./h x sq. ft. x deg F at **75 deg F** mean temperature.
b. Install spacers that position the inner duct at uniform distance from outer duct without compressing insulation.
c. Coat insulation with antimicrobial coating.
d. Cover insulation with polyester film complying with UL 181, Class 1.

9. Interstitial Insulation, Flexible Elastomeric: Duct liner complying with ASTM C534/C534M, Type II for sheet materials, and with NFPA 90A or NFPA 90B.

a. Maximum Thermal Conductivity: 0.1667 Btu x in./h x sq. ft. x deg F at **75 deg F** mean temperature.

2.4 SHEET METAL MATERIALS

A. General Material Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods. Sheet metal materials are to be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.

B. Galvanized Sheet Steel: Comply with ASTM A653/A653M.

1. Galvanized Coating Designation: G60.
2. Finishes for Surfaces Exposed to View: Mill phosphatized.
3. Lockforming Quality: Sheet steel and galvanized coating is to be able to be formed with back-to-back bends in seams such as the Pittsburgh lock at high speed without cracking or flaking of the coating on the outside of the bend.

C. PVC-Coated, Galvanized Sheet Steel: Comply with ASTM A653/A653M.

1. Galvanized Coating Designation: G60.
2. Minimum Thickness for Factory-Applied PVC Coating: 4 mils thick on sheet metal surface of ducts and fittings exposed to corrosive conditions, and minimum 1 mil thick on opposite surface.
3. Coating Materials: Acceptable to authorities having jurisdiction for use on ducts listed and labeled by an NRTL for compliance with UL 181, Class 1.

D. Carbon-Steel Sheets: Comply with ASTM A1008/A1008M, with oiled, matte finish for exposed ducts.

E. Stainless Steel Sheets: Comply with ASTM A480/A480M, Type 304 or 316, as indicated in "Duct Application Schedule" Article; cold rolled, annealed, sheet. Provide exposed surface finish No. 2B, No. 2D, No. 3, or No. 4, as indicated in "Duct Application Schedule" Article.

F. Aluminum Sheets: Comply with ASTM B209/B209M Alloy 3003, H14 temper; with mill finish for concealed ducts, and standard, one-side bright finish for duct surfaces exposed to view.

G. Factory- or Shop-Applied Antimicrobial Coating:

1. Apply to the surface of sheet metal that will form the interior surface of the duct. Provide untreated clear coating is to be applied to the exterior surface.
2. Provide antimicrobial compound tested for efficacy by an NRTL and registered by the EPA for use in HVAC systems.
3. Provide coating containing the antimicrobial compound having hardness of 2H, minimum, when tested in accordance with ASTM D3363.
4. Surface-Burning Characteristics: Maximum flame-spread index of 25 and maximum smoke-developed index of 50 when tested in accordance with UL 723; certified by an NRTL.
5. Shop-Applied Coating Color: Black.
6. Antimicrobial coating on sheet metal is not required for duct containing liner treated with antimicrobial coating.

H. Reinforcement Shapes and Plates: ASTM A36/A36M, steel plates, shapes, and bars; black and galvanized.

1. Where black- and galvanized-steel shapes and plates are used to reinforce aluminum ducts, isolate the different metals with butyl rubber, neoprene, or EPDM gasket materials.

I. Tie Rods: Galvanized steel, **1/4-inch-** minimum diameter for lengths **36 inches** or less; **3/8-inch-** minimum diameter for lengths longer than **36 inches**.

2.5 SEALANTS AND GASKETS

A. General Sealant and Gasket Requirements: Surface-burning characteristics for sealants and gaskets: Maximum flame-spread index of 25 and a maximum smoke-developed index of 50 when tested in accordance with UL 723 and certified by an NRTL.

B. Two-Part Tape Sealing System:

1. Tape: Woven cotton fiber impregnated with mineral gypsum and modified acrylic/silicone activator to react exothermically with tape to form hard, durable, airtight seal.
2. Tape Width: 3 inches.
3. Sealant: Modified styrene acrylic.
4. Water resistant.
5. Mold and mildew resistant.
6. Maximum Static Pressure: **10-inch wg**, positive and negative.
7. Service: Indoor and outdoor.
8. Service Temperature: **Minus 40 to plus 200 deg F**.
9. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum sheets.

C. Water-Based Joint and Seam Sealant:

1. Application Method: Brush on.
2. Solids Content: Minimum 65 percent.
3. Shore A Hardness: Minimum 20.
4. Water resistant.
5. Mold and mildew resistant.
6. VOC: Maximum 75 g/L (less water).
7. Maximum Static Pressure: **10-inch wg**, positive and negative.
8. Service: Indoor or outdoor.
9. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum sheets.

D. Solvent-Based Joint and Seam Sealant:

1. Application Method: Brush on.
2. Base: Synthetic rubber resin.
3. Solvent: Toluene and heptane.
4. Solids Content: Minimum 60 percent.
5. Shore A Hardness: Minimum 60.
6. Water resistant.
7. Mold and mildew resistant.
8. Maximum Static Pressure: **10-inch wg**, positive or negative.
9. Service: Indoor or outdoor.
10. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare),

stainless steel, or aluminum sheets.

E. Flanged Joint Sealant: Comply with ASTM C920.

1. General: Single component, acid curing, silicone, elastomeric.
2. Type: S.
3. Grade: NS.
4. Class: 25.
5. Use: O.

F. Flange Gaskets: Butyl rubber, neoprene, or EPDM polymer with polyisobutylene plasticizer.

G. Round Duct Joint O-Ring Seals:

1. Provide seal having maximum leakage class of **3 cfm/100 sq. ft. at 1-inch wg** and is to be rated for **10-inch wg** static pressure, positive or negative.
2. EPDM O-ring to seal in concave bead in coupling or fitting spigot.
3. Double-lipped, EPDM O-ring seal, mechanically fastened to factory-fabricated couplings and fitting spigots.

2.6 HANGERS AND SUPPORTS

A. Hanger Rods for Noncorrosive Environments: Galvanized-steel rods and nuts.

B. Hanger Rods for Corrosive Environments: Electrogalvanized, all-thread rods or galvanized rods with threads painted with zinc-chromate primer after installation.

C. Strap and Rod Sizes: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," **Table 5-1**, "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum Hanger Sizes for Round Duct."

1. Steel Cables for Galvanized-Steel Ducts: Galvanized steel complying with ASTM A603.

a. Steel Cable End Connections: Galvanized-steel assemblies with brackets, swivel, and bolts designed for duct hanger service; with an automatic-locking and clamping device.

2. Steel Cables for Stainless Steel Ducts: Stainless steel complying with ASTM A492.

a. Stainless Steel Cable End Connections: Stainless steel assemblies with brackets, swivel, and bolts designed for duct hanger service; with an automatic-locking and clamping device.

D. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.

E. Trapeze and Riser Supports: Steel shapes complying with ASTM A36/A36M.

1. Supports for Galvanized-Steel Ducts: Galvanized-steel shapes and plates.
2. Supports for Stainless Steel Ducts: Stainless steel shapes and plates.
3. Supports for Aluminum Ducts: Aluminum or galvanized steel coated with zinc chromate.

F. Strut Support System for Ductwork - Metal, Cable Type:

1. Manufacturers: Subject to compliance with requirements, provide products by the following:

   a. CADDY; brand of nVent Electrical plc
   b. Gripple Inc.

2. Source Limitations: Obtain metal cable type strut support system for ductwork from single manufacturer.
3. Description: Factory-fabricated ductwork support system consisting of cable clamps, slotted channel brackets, wire-rope suspension components, and associated accessories for a complete ductwork suspension system. No tools required for manual assembly in the field to support ductwork routing.
4. Components:

   a. Brackets: Slotted steel channels furnished in pre-cut lengths to suit specific system application for Project.
   b. Suspension Components: Hanging cables with adjustable fasteners.

      1) Wire Rope: High-tensile-steel wire rope, complying with ASTM A1023/A1023M; lengths, diameters, and wire construction to accommodate design loads.

         a) Foot attachment type to suit application.
         b) End Fix Type: Loop , strap hook , eyelet or as required to suit application.

PART 3 - EXECUTION

3.1 INSTALLATION OF DUCTS

A. Install duct systems as indicated unless deviations to layout are approved on Shop Drawings and coordination drawings.

B. Install ducts in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

C. Install ducts in maximum practical lengths with fewest possible joints.

D. Install factory- or shop-fabricated fittings for changes in direction, size, and shape and for branch connections.

E. Unless otherwise indicated, install ducts vertically and horizontally, and parallel and perpendicular to building lines.

F. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.

G. Install ducts with a minimum clearance of **1 inch**, plus allowance for insulation thickness.

H. Don't route ducts through transformer vaults and electrical equipment rooms and enclosures.

I. Where ducts pass through non-fire-rated interior partitions and exterior walls and are exposed to view, cover the opening between the partition and duct or duct insulation with sheet metal flanges of same metal thickness as the duct. Overlap openings on four sides by at least **1-1/2 inches**.

J. Install fire , combination fire/smoke, and smoke dampers where indicated on Drawings and as required by code, and by local authorities having jurisdiction. Comply with requirements in Section 233300 "Air Duct Accessories" for fire and smoke dampers and specific installation requirements of the damper UL listing.

K. Install duct access panel assemblies at each fire , combination fire/smoke, and smoke damper to permit damper inspection and testing.

L. Install heating coils, cooling coils, air filters, dampers, and all other duct-mounted accessories in air ducts where indicated on Drawings.

M. Protect duct interiors from moisture, construction debris and dust, and other foreign materials both before and after installation. Comply with SMACNA's "IAQ Guidelines for Occupied Buildings Under Construction," Appendix G, "Duct Cleanliness for New Construction Guidelines."

N. Elbows: Use long-radius elbows wherever they fit.

1. Fabricate 90-degree rectangular mitered elbows to include turning vanes.
2. Fabricate 90-degree round elbows with a minimum of three segments for **12 inches** and smaller and a minimum of five segments for **14 inches** and larger.

O. Branch Connections: Use lateral or conical branch connections.

P. Installation of Metal, Cable-Type Strut Support System for Ductwork: Install in accordance with manufacturer's written installation instructions.

3.2 ADDITIONAL INSTALLATION REQUIREMENTS FOR EXPOSED DUCTWORK

A. Protect ducts exposed in finished spaces from being dented, scratched, or damaged.

B. Trim duct sealants flush with metal. Create a smooth and uniform exposed bead.

C. Two-Part Tape Sealing System: Unacceptable.

D. Grind welds to provide smooth surface free of burrs, sharp edges, and weld splatter.

When welding stainless steel with a No. 3 or 4 finish, grind the welds flush, polish the exposed welds, and treat the welds to remove discoloration caused by welding.

E. Maintain consistency, symmetry, and uniformity in arrangement and fabrication of fittings, hangers and supports, duct accessories, and air outlets. Remove all stickers and other installation markings.

F. Repair or replace damaged sections and finished work that do not comply with these requirements.

3.3 ADDITIONAL INSTALLATION REQUIREMENTS FOR TYPE 1 COMMERCIAL KITCHEN GREASE HOOD EXHAUST DUCTS

A. Install ducts in accordance with NFPA 96, SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," and SMACNA's "Kitchen Ventilation Systems and Food Service Equipment Fabrication and Installation Guidelines" and requirements of authorities having jurisdiction.

B. Install all ducts without dips and traps that may hold grease, and sloped a minimum of 2 percent to drain grease back to the hood.

C. All ducts exposed to view are to be in accordance with "Duct Application Schedule" Article. All ducts concealed from view are to be in accordance with "Duct Application Schedule" Article.

D. Fabricate welded joints and seams of telescoping, bell, or flange joints in accordance with NFPA 96.

E. Install fire-rated access panel assemblies at each change in direction and at maximum intervals of 20 ft. in horizontal ducts, and at every floor for vertical ducts, or as indicated on Drawings.

F. Do not penetrate fire-rated assemblies except as allowed by applicable building codes and authorities having jurisdiction.

3.4 ADDITIONAL INSTALLATION REQUIREMENTS FOR EXHAUST DUCTS SERVING COMMERCIAL DISHWASHERS AND OTHER HIGH-HUMIDITY LOCATIONS

A. Install dishwasher exhaust ducts and other exhaust ducts from wet, high-humidity locations without dips and traps that may hold water. Slope ducts a minimum of 2 percent back to dishwasher or toward drain.

B. Provide a drain pocket at each low point and at the base of each riser with a **1-inch** trapped copper drain from each drain pocket to open-sight floor drain.

C. Minimize number of transverse seams.

D. Do not locate longitudinal seams on bottom of duct.

3.5 ADDITIONAL INSTALLATION REQUIREMENTS FOR LABORATORY EXHAUST AND FUME HOOD EXHAUST DUCTS

A. Install ducts in accordance with NFPA 45 and requirements of authorities having jurisdiction.

B. Install exhaust ducts without dips and traps that may hold water. Slope ducts a minimum of 2 percent back to hood or inlet. Where indicated on Drawings, install trapped drain piping.

C. Connect duct to fan, fume hood, and other equipment indicated on Drawings.

3.6 ADDITIONAL REQUIREMENTS FOR DUCTWORK EXPOSED TO WEATHER

A. All external joints are to be welded. Seal all openings to provide weatherproof construction.

B. Construct ductwork to resist external loads of wind, snow, ice, and other effects of weather. Provide necessary supporting structures.

C. Ductwork Exterior Surface Treatment:

1. Single Wall:

    a. If galvanized duct is indicated in "Duct Application Schedule" Article and if outer surface is uninsulated, protect outer surface with suitable paint. Paint materials and application requirements are specified in Section 099113 "Exterior Painting."
    b. Where ducts have external insulation, provide weatherproof aluminum jacket. See Section 230713 "Duct Insulation."

2. Double Wall:

    a. If galvanized duct is indicated in "Duct Application Schedule" Article, protect outer surface with suitable paint. Paint materials and application requirements are specified in Section 099113 "Exterior Painting."

D. Material: See "Duct Application Schedule" Article for duct materials.

3.7 DUCT SEALING

A. Seal ducts for duct static-pressure, seal classes, and leakage classes specified in "Duct Application Schedule" Article in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

B. Minimum Seal Class: Seal ducts at a minimum to the following seal classes in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible":

1. Outdoor, Supply-Air Ducts: Seal Class A.
2. Outdoor, Exhaust Ducts: Seal Class A.

3. Outdoor, Return-Air Ducts: Seal Class A.
4. Unconditioned Space, Supply-Air Ducts in Pressure Rating of 2-Inch wg (500 Pa) and Lower: Seal Class B.
5. Unconditioned Space, Supply-Air Ducts in Pressure Rating Higher than 2-Inch wg (500 Pa): Seal Class A.
6. Unconditioned Space, Exhaust Ducts: Seal Class C.
7. Unconditioned Space, Return-Air Ducts: Seal Class B.
8. Conditioned Space, Supply-Air Ducts in Pressure Ratings of 2-Inch wg (500 Pa) and Lower: Seal Class C.
9. Conditioned Space, Supply-Air Ducts in Pressure Rating Higher than 2-Inch wg (500 Pa): Seal Class B.
10. Conditioned Space, Exhaust Ducts: Seal Class B.
11. Conditioned Space, Return-Air Ducts: Seal Class C.

3.8 INSTALLATION OF HANGERS AND SUPPORTS

A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 5, "Hangers and Supports."

B. Building Attachments: Concrete inserts, powder-actuated fasteners, or structural-steel fasteners appropriate for construction materials to which hangers are being attached.

1. Where practical, install concrete inserts before placing concrete.
2. Install powder-actuated concrete fasteners after concrete is placed and completely cured.
3. Use powder-actuated concrete fasteners for standard-weight aggregate concretes or for slabs more than **4 inches** thick.
4. Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes or for slabs less than **4 inches** thick.
5. Do not use powder-actuated concrete fasteners for seismic restraints. Coordinate with Section 230548 "Vibration and Seismic Controls for HVAC."

C. Hanger Spacing: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," **Table 5-1**, "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum Hanger Sizes for Round Duct," for maximum hanger spacing; install hangers and supports within **24 inches** of each elbow and within **48 inches** of each branch intersection.

D. Hangers Exposed to View: Threaded rod and angle or channel supports.

E. Support vertical ducts with steel angles or channel secured to the sides of the duct with welds, bolts, sheet metal screws, or blind rivets; support at each floor and at a maximum intervals of **16 ft.**.

F. Install upper attachments to structures. Select and size upper attachments with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

3.9 INSTALLATION OF SEISMIC-RESTRAINT DEVICES

A. See Section 230548 "Vibration and Seismic Controls for HVAC" for seismic restraint installation requirements.

3.10 DUCTWORK CONNECTIONS

A. Make connections to equipment with flexible connectors complying with Section 233300 "Air Duct Accessories."

B. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for branch, outlet and inlet, and terminal unit connections.

3.11 PAINTING

A. Paint interior of metal ducts that are visible through registers and grilles and that do not have duct liner. Apply one coat of flat, black, latex paint over a compatible galvanized-steel primer. Paint materials and application requirements are specified in Section 099113 "Exterior Painting" and Section 099123 "Interior Painting."

B. For painting of interior exposed metal ducts, see Section 099123 "Interior Painting."

C. For painting of exterior metal ducts, see Section 099113 "Exterior Painting."

3.12 FIELD QUALITY CONTROL

A. Leakage Tests: Comply with SMACNA's "HVAC Air Duct Leakage Test Manual." Submit a test report for each test. Test the following systems:

1. Ducts with a Pressure Rating Higher than 3-Inch wg (750 Pa): Test representative duct sections , selected by Architect from sections installed, totaling no less than 25 percent of total installed duct area for each designated pressure rating.
2. Supply Ducts: For pressure rating of 3-inch wg or higher; test representative duct sections totaling no less than 50 percent of total installed duct area for each designated pressure rating.
3. Return Ducts: For a pressure rating of 2-inch wg or higher; test representative duct sections totaling no less than 50 percent of total installed duct area for each designated pressure rating.
4. Exhaust Ducts: For a pressure rating of 2-inch wg or higher; test representative duct sections totaling no less than 50 percent of total installed duct area for each designated pressure rating.
5. Outdoor-Air Ducts: For a pressure rating of 2-inch wg or higher; test representative duct sections totaling no less than 50 percent of total installed duct area for each designated pressure rating.
6. Disassemble, reassemble, and seal segments of systems to accommodate leakage testing and for compliance with test requirements.
7. Testing of each duct section is to be performed with access doors, coils, filters,

dampers, and other duct-mounted devices in place as designed. No devices are to be removed or blanked off so as to reduce or prevent additional leakage.
8. Test for leaks before applying external insulation.
9. Conduct tests at static pressures equal to maximum design pressure of system or section being tested. If static-pressure ratings are not indicated, test system at maximum system design pressure. Do not pressurize systems above maximum design operating pressure.
10. Give seven days' advance notice for testing.

B. Duct System Cleanliness Test Procedure:

1. Visually inspect duct system to ensure that no visible contaminants are present.
2. Test sections of metal duct system, chosen randomly by Owner.
3. Perform duct system cleanliness verification utilizing test procedure presented in NADCA ACR, Section 5 - "Cleanliness Verification and Documentation."

a. Acceptable Cleanliness Level: Net weight of debris collected on the filter media is to not exceed 0.75 mg/100 sq. cm..

C. Duct system will be considered defective if it does not pass tests and inspections.

D. Prepare test and inspection reports.

3.13 DUCT CLEANING

A. Clean new duct system(s) before testing, adjusting, and balancing.

B. For cleaning of existing ductwork, see Section 230130.52 "Existing HVAC Air Distribution System Cleaning."

C. Use duct cleaning methodology as indicated in NADCA ACR.

D. Use service openings for entry and inspection.

1. Provide openings with access panels appropriate for duct static-pressure and leakage class at dampers, coils, and any other locations where required for inspection and cleaning access. Provide insulated panels for insulated or lined duct. Patch insulation and liner as recommended by duct liner manufacturer. Comply with Section 233300 "Air Duct Accessories" for access panels and doors.
2. Disconnect and reconnect flexible ducts as needed for cleaning and inspection.
3. Remove and reinstall ceiling to gain access during the cleaning process.

E. Particulate Collection and Odor Control:

1. When venting vacuuming system inside the building, use HEPA filtration with 99.97 percent collection efficiency for 0.3-micron-size (or larger) particles.
2. When venting vacuuming system to outdoors, use filter to collect debris removed from HVAC system, and locate exhaust downwind and away from air intakes and other points of entry into building.

F. Cleaning: Clean the following components by removing surface contaminants and deposits:

1. Air outlets and inlets (registers, grilles, and diffusers).
2. Supply, return, and exhaust fans including fan housings, plenums (except ceiling supply and return plenums), scrolls, blades or vanes, shafts, baffles, dampers, and drive assemblies.
3. Air-handling unit internal surfaces and components including mixing box, coil section, air wash systems, spray eliminators, condensate drain pans, humidifiers and dehumidifiers, filters and filter sections, and condensate collectors and drains.
4. Coils and related components.
5. Return-air ducts, dampers, actuators, and turning vanes except in ceiling plenums and mechanical equipment rooms.
6. Supply-air ducts, dampers, actuators, and turning vanes.
7. Dedicated exhaust and ventilation components and makeup air systems.

G. Mechanical Cleaning Methodology:

1. Clean metal duct systems using mechanical cleaning methods that extract contaminants from within duct systems and remove contaminants from building.
2. Use vacuum-collection devices that are operated continuously during cleaning. Connect vacuum device to downstream end of duct sections so areas being cleaned are under negative pressure.
3. Use mechanical agitation to dislodge debris adhered to interior duct surfaces without damaging integrity of metal ducts, duct liner, or duct accessories.
4. Clean fibrous-glass duct liner with HEPA vacuuming equipment; do not permit duct liner to get wet. Replace fibrous-glass duct liner that is damaged, deteriorated, or delaminated or that has friable material, mold, or fungus growth.
5. Clean coils and coil drain pans in accordance with NADCA ACR. Keep drain pan operational. Rinse coils with clean water to remove latent residues and cleaning materials; comb and straighten fins.
6. Provide drainage and cleanup for wash-down procedures.
7. Antimicrobial Agents and Coatings: Apply EPA-registered antimicrobial agents if fungus is present. Apply antimicrobial agents in accordance with manufacturer's written instructions after removal of surface deposits and debris.

3.14 DUCT APPLICATION SCHEDULE

A. Fabricate all ducts to achieve SMACNA pressure rating, seal class, and leakage class as indicated below.

B. Supply Ducts:

1. Ducts Connected to Fan Coil Units, Furnaces, Heat Pumps, and Terminal Units:

a. Pressure Rating: Positive 2-inch wg.
b. Minimum SMACNA Seal Class: B.
c. SMACNA Leakage Class for Rectangular: 8.
d. SMACNA Leakage Class for Round and Flat Oval: 4.

e. Material: Type G90 galvanized steel.

2. Ducts Connected to Constant-Volume Air-Handling Units:

a. Pressure Rating: Positive 2-inch wg.
b. Minimum SMACNA Seal Class: B.
c. SMACNA Leakage Class for Rectangular: 8.
d. SMACNA Leakage Class for Round and Flat Oval: 4.
e. Material: Type G90 galvanized steel.

3. Ducts Connected to Variable-Air-Volume Air-Handling Units:

a. Pressure Rating: Positive 4-inch wg.
b. Minimum SMACNA Seal Class: A.
c. SMACNA Leakage Class for Rectangular: 2.
d. SMACNA Leakage Class for Round and Flat Oval: 2.
e. Material: Type G90 galvanized steel.

4. Ducts Connected to Equipment Not Listed Above:

a. Pressure Rating: Positive 2-inch wg.
b. Minimum SMACNA Seal Class: C.
c. SMACNA Leakage Class for Rectangular: 8.
d. SMACNA Leakage Class for Round and Flat Oval: 4.
e. Material: Type G90 galvanized steel.

5. Ducts Serving or Passing Through Areas Containing Equipment Highly Sensitive to Magnetic Fields (Such as MRIs):

a. Material: Ducts and all fittings, supports, and other accessories to be aluminum.
b. Pressure Rating: Positive 3-inch wg.
c. Minimum SMACNA Seal Class: A.
d. SMACNA Leakage Class for Rectangular: 2.
e. SMACNA Leakage Class for Round and Flat Oval: 2.

C. Return Ducts:

1. Ducts Connected to Fan Coil Units, Furnaces, Heat Pumps, and Terminal Units:

a. Pressure Rating: Positive or negative 2-inch wg.
b. Minimum SMACNA Seal Class: B.
c. SMACNA Leakage Class for Rectangular: 8.
d. SMACNA Leakage Class for Round and Flat Oval: 4.
e. Material: Type G90 galvanized steel.

2. Ducts Connected to Air-Handling Units:

a. Pressure Rating: Positive or negative 3-inch wg.
b. Minimum SMACNA Seal Class: A.
c. SMACNA Leakage Class for Rectangular: 4.

d. SMACNA Leakage Class for Round and Flat Oval: 2.
e. Material: Type G90 galvanized steel.

3. Ducts Connected to Equipment Not Listed Above:

a. Pressure Rating: Positive or negative 2-inch wg.
b. Minimum SMACNA Seal Class: B.
c. SMACNA Leakage Class for Rectangular: 8.
d. SMACNA Leakage Class for Round and Flat Oval: 4.
e. Material: Type G90 galvanized steel.

4. Ducts Serving or Passing Through Areas Containing Equipment Highly Sensitive to Magnetic Fields (Such as MRIs):

a. Material: Ducts and all fittings, supports, and other accessories to be aluminum.
b. Pressure Rating: Positive 3-inch wg.
c. Minimum SMACNA Seal Class: A.
d. SMACNA Leakage Class for Rectangular: 2.
e. SMACNA Leakage Class for Round and Flat Oval: 2.

D. Exhaust Ducts:

1. Ducts Connected to Fans Exhausting (ASHRAE 62.1, Class 1 and 2) Air:

a. Pressure Rating: Negative 2-inch wg.
b. Minimum SMACNA Seal Class: B if negative pressure, and A if positive pressure.
c. SMACNA Leakage Class for Rectangular: 8.
d. SMACNA Leakage Class for Round and Flat Oval: 4.
e. Material: Type G90 galvanized steel.

2. Ducts Connected to Air-Handling Units:

a. Pressure Rating: Positive or negative 3-inch wg.
b. Minimum SMACNA Seal Class: A if negative pressure, and A if positive pressure.
c. SMACNA Leakage Class for Rectangular: 4.
d. SMACNA Leakage Class for Round and Flat Oval: 2.
e. Material: Type G90 galvanized steel.

3. Ducts Connected to Commercial Kitchen Hoods: Comply with NFPA 96.

a. Material:

1) Exposed to View: Type 304 stainless steel sheet, No. 4 finish.
2) Concealed: Type 304, stainless steel sheet, No. 2D finish.

b. Welded seams and joints.
c. Pressure Rating: Positive or negative 3-inch wg.
d. Airtight/watertight.

4. Ducts Connected to Dishwashers, Dishwasher Hoods, and Other High-Humidity Locations:

    a. Material: Type 304 stainless steel sheet.

        1) Exposed to View: No. 4 finish.
        2) Concealed: No. 2D finish.

    b. Welded longitudinal seams; welded or flanged transverse joints with watertight EPDM gaskets.
    c. Pressure Rating: Positive or negative 2-inch wg.
    d. Airtight/watertight.

5. Ducts Connected to Fans Exhausting Fume Hood, Laboratory, and Process (ASHRAE 62.1, Class 3 and Class 4) Air:

    a. Material: Type 316, stainless steel sheet.

        1) Exposed to View: No. 4 finish.
        2) Concealed: No. 2B finish.

    b. PVC-coated, galvanized sheet steel with thicker coating on duct interior.
    c. Pressure Rating: Positive or negative 3-inch wg.
    d. Seal Class: Minimum SMACNA Seal Class A.
    e. Joints: Welded seams and joints, airtight/watertight.
    f. Leakage Class: SMACNA Leakage Class 2.

6. Ducts Connected to Equipment Not listed Above:

    a. Pressure Rating: Positive or negative 2-inch wg.
    b. Minimum SMACNA Seal Class: B if negative pressure; A if positive pressure.
    c. SMACNA Leakage Class for Rectangular: 8.
    d. SMACNA Leakage Class for Round and Flat Oval: 4.
    e. Material: Type G90 galvanized steel.

E. Outdoor-Air (Not Filtered, Heated, or Cooled) Ducts:

1. Ducts Connected to Fan Coil Units, Furnaces, Heat Pumps, and Terminal Units:

    a. Pressure Rating: Positive or negative 1-inch wg.
    b. Minimum SMACNA Seal Class: C.
    c. SMACNA Leakage Class for Rectangular: 8.
    d. SMACNA Leakage Class for Round and Flat Oval: 8.
    e. Material: Type G90 galvanized steel.

2. Ducts Connected to Air-Handling Units:

    a. Pressure Rating: Positive or negative 2-inch wg.
    b. Minimum SMACNA Seal Class: B.
    c. SMACNA Leakage Class for Rectangular: 8.

d. SMACNA Leakage Class for Round and Flat Oval: 4.
e. Material: Type G90 galvanized steel.

3. Ducts Connected to Equipment Not Listed Above:

a. Pressure Rating: Positive or negative 3-inch wg.
b. Minimum SMACNA Seal Class: B.
c. SMACNA Leakage Class for Rectangular: 8.
d. SMACNA Leakage Class for Round and Flat Oval: 4.
e. Material: Type G90 galvanized steel.

F. Underground Ducts: Concrete-encased, galvanized sheet steel.

G. All Other Ductwork Not Specifically Noted Otherwise: Galvanized steel.

H. Intermediate Reinforcement:

1. Galvanized-Steel Ducts: G90 galvanized steel.
2. PVC-Coated Ducts:

a. Exposed to Airstream: Match duct material.
b. Not Exposed to Airstream: Galvanized.

3. Stainless Steel Ducts:

a. Exposed to Airstream: Match duct material.
b. Not Exposed to Airstream: Galvanized.

4. Aluminum Ducts: Aluminum.

I. Double-Wall Duct Interstitial Insulation:

1. Supply-Air Ducts: 2 inches thick.
2. Return-Air Ducts: 2 inches thick.
3. Exhaust-Air Ducts: 2 inches thick.

J. Elbow Configuration:

1. Rectangular Duct - Requirements for Different Velocities: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-2, "Rectangular Elbows."

a. Velocity 1000 fpm (5 m/s) or Lower:

1) Radius Type RE 1 with minimum 0.5 radius-to-diameter ratio.
2) Mitered Type RE 4 without vanes.

b. Velocity 1000 to 1500 fpm (5 to 7.6 m/s):

1) Radius Type RE 1 with minimum 1.0 radius-to-diameter ratio.
2) Radius Type RE 3 with minimum 0.5 radius-to-diameter ratio and two vanes.

3) Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-3, "Vanes and Vane Runners," and Figure 4-4, "Vane Support in Elbows."

c. Velocity 1500 fpm (7.6 m/s) or Higher:

1) Radius Type RE 1 with minimum 1.5 radius-to-diameter ratio.
2) Radius Type RE 3 with minimum 1.0 radius-to-diameter ratio and two vanes.
3) Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-3, "Vanes and Vane Runners," and Figure 4-4, "Vane Support in Elbows."

2. Rectangular Duct - Requirements for All Velocities: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-2, "Rectangular Elbows."

a. Radius Type RE 1 with minimum 1.5 radius-to-diameter ratio.
b. Radius Type RE 3 with minimum 1.0 radius-to-diameter ratio and two vanes.
c. Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-3, "Vanes and Vane Runners," and Figure 4-4, "Vane Support in Elbows."

3. Round Duct and Flat Oval: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-4, "Round Duct Elbows."

a. Minimum Radius-to-Diameter Ratio and Elbow Segments: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 3-1, "Mitered Elbows." Elbows with less than 90-degree change of direction have proportionately fewer segments.

1) Velocity 1000 fpm (5 m/s) or Lower: 0.5 radius-to-diameter ratio and three segments for 90-degree elbow.
2) Velocity 1000 to 1500 fpm (5 to 7.6 m/s): 1.0 radius-to-diameter ratio and four segments for 90-degree elbow.
3) Velocity 1500 fpm (7.6 m/s) or Higher: 1.5 radius-to-diameter ratio and five segments for 90-degree elbow.
4) Radius-to-Diameter Ratio: 1.5.

b. Round and Flat Oval Elbows:

1) Stamped or pleated for 12 inches and smaller diameters.
2) Standing seam for 14 inches and larger diameter.
3) Welded for 14 inches and larger diameter.

K. Branch Configuration:

1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards

- Metal and Flexible," Figure 4-6, "Branch Connection."

a. Rectangular Main to Rectangular Branch: 45-degree entry.
b. Rectangular Main to Round Branch: Conical spin in.

2. Round and Flat Oval: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-5, "90 Degree Tees and Laterals," and Figure 3-6, "Conical Tees." Saddle taps are permitted in existing duct.

a. Velocity 1000 fpm (5 m/s) or Lower: 90-degree tap.
b. Velocity 1000 to 1500 fpm (5 to 7.6 m/s): Conical tap.
c. Velocity 1500 fpm (7.6 m/s) or Higher: 45-degree lateral.

END OF SECTION 23 31 13

SECTION 23 31 16 - NONMETAL DUCTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Fibrous-glass ducts and fittings.
2. HDPE ducts and fittings.
3. Hangers and supports for nonmetal ducts.

B. Related Requirements:

1. Section 018123 "Facility Seismic and Wind Criteria" specifies basis-of-design seismic and wind criteria for nonstructural components.
2. Section 230130.52 "Existing HVAC Air Distribution System Cleaning" for cleaning of existing HVAC air-distribution equipment, ducts, plenums, and system components.
3. Section 230548 "Vibration and Seismic Controls for HVAC" for vibration-isolated and restrained ductwork hangers and supports.
4. Section 230548.13 "Vibration Controls for HVAC" for vibration-isolated ductwork and hangers.
5. Section 230593 "Testing, Adjusting, and Balancing for HVAC" for duct system testing, adjusting, and balancing.
6. Section 230800 "Commissioning of HVAC" for HVAC commissioning procedures.
7. Section 233113 "Metal Ducts" for single- and double-wall, rectangular and round ducts.
8. Section 233119.13 "Shop-Fabricated HVAC Casings" for shop-fabricated casings for mechanical equipment.
9. Section 233119.16 "Manufactured HVAC Casings" for factory-manufactured casings for mechanical equipment.
10. Section 233300 "Air Duct Accessories" for dampers, sound-control devices, duct-mounted access doors and panels, turning vanes, and flexible ducts.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Construction details.
2. Materials.
3. Dimension of individual components.
4. Finishes.
5. Operating characteristics.
6. Furnished accessories.

B. Shop Drawings:

1. Fabrication, assembly, and installation, including plans, elevations, sections, components, and attachments to other work.
2. Duct layout indicating sizes and pressure classes.
3. Elevation of top and bottom of ducts.
4. Dimensions of main duct runs from building grid lines.
5. Fittings.
6. Reinforcement and spacing.
7. Seam and joint construction.
8. Penetrations through fire-rated, smoke-rated, and other partitions.
9. Fire and smoke damper locations.
10. Equipment installation based on equipment being used on Project.
11. Hangers and supports, including methods for duct and building attachment and vibration isolation.

C. Delegated Design Submittals: For nonmetal ducts, signed and sealed by a qualified professional engineer.

1. Duct materials and thicknesses.
2. Joint and seam construction and sealing.
3. Reinforcement details and spacing.
4. Materials, fabrication, assembly, and spacing of hangers and supports .

1.3 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Plans, or BIM model, drawn to scale, showing the items described in this Section and coordinated with all building trades.

B. Seismic Qualification Data: Manufacturer certificates for nonmetal ducts, accessories, and components.

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
3. Anchorage Devices: Detailed description of equipment anchorage devices on which the certification is based, and their installation requirements.

C. Welding certificates.

D. Field quality control and test reports.

1.4 QUALITY ASSURANCE

A. Hanger and Support Welding Qualifications: Qualify procedures and personnel in accordance with the following:

1. AWS D1.1/D1.1M for steel hangers and supports.
2. AWS D1.2/D1.2M for aluminum hangers and supports.

1.5 WARRANTY

A. Warranty: Manufacturer agrees to repair or replace components of ductwork system that fail in material or workmanship within specified warranty period.

1. Warranty Period, HDPE Duct System: 10 year(s) from date of Substantial Completion.
2. Warranty Period, Thermoset FRP Duct System: 10 year(s) from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Delegated Duct Design: Duct construction, including duct closure, reinforcements, and hangers and supports, is to comply with the SMACNA publications cited below and with performance requirements and design criteria indicated in "Duct Application Schedule" Article.

1. SMACNA's "Fibrous Glass Duct Construction Standards."
2. SMACNA's "Phenolic Duct Construction Standards."
3. SMACNA's "Thermoplastic Duct (PVC) Construction Manual."
4. SMACNA's "Thermoset FRP Duct Construction Manual."
5. Static-Pressure Ratings:

    a. Supply Ducts except in Mechanical Rooms: 2-inch wg.
    b. Supply Ducts Upstream from Air Terminal Units: 2-inch wg.
    c. Supply Ducts Downstream from Air Terminal Units: 1-inch wg.
    d. Supply Ducts in Mechanical Equipment Rooms: 2-inch wg.
    e. Return Ducts Negative Pressure: 1-inch wg.
    f. Exhaust Ducts Negative Pressure: 1-inch wg.

B. Wind-Restraint Performance:

1. See Section 230548.13 "Vibration Controls for HVAC" and Section 018123 "Facility Seismic and Wind Criteria" for requirements.

C. Airstream Surfaces: Surfaces in contact with the airstream are to comply with requirements in ASHRAE 62.1, Section 5.4 - "Airstream Surfaces."

D. ASHRAE 62.1 Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and System Start-up."

E. ASHRAE/IES 90.1 Compliance: Applicable requirements in ASHRAE/IES 90.1, Section 6.4.4 - "HVAC System Construction and Insulation."

F. Duct Dimensions: Unless otherwise indicated, all duct dimensions indicated on Drawings are inside clear dimensions and do not include insulation or duct wall thickness.

G. NFPA Compliance:

1. NFPA 90A.
2. NFPA 90B.

2.2 FIBROUS-GLASS DUCTS AND FITTINGS

A. Fibrous-Glass Duct and Fittings:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

    a. CertainTeed; SAINT-GOBAIN
    b. Johns Manville; a Berkshire Hathaway company
    c. Knauf Insulation
    d. Owens Corning

2. Source Limitations: Obtain fibrous-glass duct system components from single manufacturer.
3. Description: Resin-bonded fiberglass, faced on the outside surface with FSK vapor retarder and with a smooth fiberglass mat finish on the air-side surface.
4. Duct Board: Factory molded into rectangular boards.
5. Temperature Limits: **40 to 250 deg F** inside ducts; **150 deg F** ambient temperature surrounding ducts.
6. Maximum Thermal Conductivity: 0.1667 at **75 deg F** mean temperature.
7. Moisture Absorption: Not exceeding 5 percent by weight at **120 deg F** and 95 percent relative humidity for 96 hours when tested in accordance with ASTM C1104/C1104M.
8. Acoustical Performance: Conform to sound absorption coefficients listed in NAIMA AH116.
9. Permeability: **0.02 perm** maximum when tested in accordance with ASTM E96/E96M, Procedure A.
10. Antimicrobial Agent: Compound is to be tested for efficacy by an NRTL and registered by the EPA for use in HVAC systems.
11. Noise-Reduction Coefficient: 0.65 minimum when tested in accordance with ASTM C423, Mounting A.
12. Flame Spread/Smoke Developed Rating: Duct material is to comply with UL 181, Class 1, maximum flame-spread index of 25 and maximum smoke-developed index of 50 when tested by an NRTL in accordance with ASTM E84.
13. Required Markings: EI stiffness rating, UL label, and other markings required by UL 181 on each full sheet of duct board.
14. Fibrous-Glass Closure Materials:

    a. Pressure-Sensitive Tape: Aluminum foil-scrim pressure-sensitive tape imprinted with listing information by manufacturer with coding "181A-P," manufacturer's name, and a date code.

        1) Standard: UL 181A.
        2) Minimum Tape Width: **2-1/2 inches**; **3 inches** for duct board thicker

than **1 inch**.
3) Staples: **1/2-inch** outward clinching, **2 inches** o.c. in tabs, one tab per joint.
4) Water resistant.
5) Mold and mildew resistant.

b. Heat-Activated Tape: Aluminum foil-scrim heat-activated tape imprinted with listing information by manufacturer with coding "181A-H," manufacturer's name, and a date code.

1) Standard: UL 181A.
2) Minimum Tape Width: **3 inches**.
3) Heat-Sensitive Imprint: Printed indicator on tape to show proper heating during application has been achieved.
4) Water resistant.
5) Mold and mildew resistant.

c. Two-Part Tape Sealing System: Woven glass fiber tape impregnated with mineral gypsum, imprinted with listing information by manufacturer with coding "181A-M," manufacturer's name, and a date code.

1) Standard: UL 181A.
2) Minimum Tape Width: **3 inches**.
3) Sealant: Modified styrene acrylic.
4) Water resistant.
5) Mold and mildew resistant.

d. Verify sealant has a VOC content of 420 g/L or less.
e. Verify sealant complies with testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
f. Verify sealant complies with testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers." Verify formaldehyde emissions do not exceed 9 mcg/cu. m or 7 ppb, whichever is less.
g. Verify sealant complies with testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers." Verify the building concentration of formaldehyde does not exceed half of the indoor recommended exposure limit, or 33 mcg/cu. m, and that of acetaldehyde does not exceed 9 mcg/cu. m.

15. Fabrication of Fibrous-Glass Duct and Fittings:

a. For joints, seams, transitions, elbows, and branch connections as well as for reinforcements, including channel and tie rod reinforcement materials, spacing, and fabrications, comply with SMACNA's "Fibrous Glass Duct Construction Standards," Ch. 3, "Specifications and Closure," and Ch. 4,

"Fittings and Connections."

b. Fabricate 90-degree mitered elbows to include turning vanes.

16. Reinforcement of Fibrous-Glass Ducts: Comply with requirements in SMACNA's "Fibrous Glass Duct Construction Standards," Ch. 5, "Reinforcement" for channel- and tie-rod reinforcement materials, spacing, and fabrication.

2.3 HDPE DUCTS AND FITTINGS

A. HDPE Duct and Fittings:

1. Manufacturers: Subject to compliance with requirements, provide products by the following:

   a. AQC Industries, LLC

2. Source Limitations: Obtain HDPE duct system components from single manufacturer.
3. Description: Complete HDPE underground duct system consisting of factory-manufactured components to suit duct layout configuration including straight round duct, elbows, plenums, run-outs, diffuser boots, fitting clamps, gaskets, bolts, sealant, and other components required for a complete underground ductwork system.
4. Materials:

   a. Closed-cell recyclable HDPE plastic.
   b. Material is to emit no VOCs.
   c. Leakage: Air leakage to not exceed SMACNA Leakage Class 3 requirements at system design static pressure.
   d. Thermal Distribution Efficiency: Inherent R-10 equivalent thermal insulation efficiency without using a separate insulation layer, tested in accordance with NSF P374 protocol and verified by an NSF thermal testing report.
   e. To be resistant to mildew, mold, and rust.
   f. To remain stable, without cracking, when subjected to underground stresses and strains.
   g. Rated for maximum **10-inch wg** positive pressure and maximum rated **2-inch wg** negative pressure.
   h. Surface-Burning Characteristics: Flame-spread index of 200 or less when tested in accordance with ASTM E84.
   i. Flood Plain Elevation: Tested to withstand **8-foot** water column pressure for seven days with no leakage.

5. Joining Materials:

   a. Flanged Ductwork: Join with stainless steel bolts and water- and UV-resistant copolymer adhesive caulking sealant.
   b. Unflanged Ductwork:

      1) Clamps: Polyethylene clamps with stainless steel plates and stainless steel screws.

2) Gaskets: Butyl rubber gaskets, minimum **0.25 inch** thick.

2.4 HANGERS AND SUPPORTS FOR NONMETAL DUCTS

A. Hanger Rods for Noncorrosive Environments: Zinc-plated steel rods and nuts.

B. Hanger Rods for Corrosive Environments: Electrogalvanized, all-thread rods or galvanized rods with threads painted with zinc-chromate primer after installation.

C. Strap and Rod Sizes: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," **Table 5-1**, "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum Hanger Sizes for Round Duct."

D. Steel Cables: ASTM A603, galvanized-steel cables with end connections made of zinc-plated steel assemblies with brackets, swivel, and bolts designed for duct hanger service; with an automatic-locking and clamping device.

E. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.

F. Trapeze and Riser Supports: Steel shapes complying with ASTM A36/A36M.

1. Supports for Nonmetal Ducts: Aluminum or galvanized steel coated with zinc chromate.

G. Strut Support System for Ductwork - Metal, Cable Type:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. CADDY; brand of nVent Electrical plc
b. Gripple Inc.

2. Source Limitations: Obtain metal cable-type strut support system for ductwork from single manufacturer.
3. Description: Factory-fabricated ductwork support system consisting of cable clamps, slotted channel brackets, wire-rope suspension components, and associated accessories for a complete ductwork suspension system. No tools required for manual assembly in the field to support ductwork routing.
4. Components:

a. Brackets: Slotted steel channels furnished in pre-cut lengths to suit specific system application for Project.
b. Suspension Components: Hanging cables with adjustable fasteners.

1) Wire Rope: High-tensile-steel wire rope complying with ASTM A1023/ASTM 1023M; lengths, diameters, and wire construction to accommodate design loads.

a) Foot attachment type to suit application.

b) End Fix Type: Loop , strap hook , eyelet or as required to suit application.

PART 3 - EXECUTION

3.1 INSTALLATION OF NONMETAL DUCTS

A. Install duct systems as indicated unless deviations to layout are approved on Shop Drawings and Coordination Drawings.

B. Install duct sections in maximum practical lengths with fewest possible joints.

C. Install factory- or shop-fabricated fittings for changes in direction, size, and shape and for branch connections.

D. Unless otherwise indicated, install ducts vertically and horizontally, and parallel and perpendicular to building lines.

E. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.

F. Install ducts with a minimum clearance of **1 inch**, plus allowance for insulation thickness.

G. Route ducts to avoid passing through transformer vaults and electrical equipment rooms and enclosures.

H. Where ducts pass through non-fire-rated interior partitions and exterior walls, and are exposed to view, cover the opening between the partition and duct or duct insulation with sheet metal flanges. Overlap openings on four sides by at least **1-1/2 inches**.

I. Install fire , combination fire/smoke, and smoke dampers where indicated on Drawings and as required by code and by authorities having jurisdiction. Comply with requirements in Section 233300 "Air Duct Accessories" for fire and smoke dampers and specific installation requirements of the fire damper UL listing.

J. Install fire-rated access panel assemblies at each fire , combination fire/smoke, and smoke damper to permit damper inspection and testing.

K. Install heating coils, cooling coils, air filters, dampers, and all other duct-mounted accessories in air ducts where indicated on Drawings.

L. Protect duct interiors from moisture, construction debris and dust, and other foreign materials both before and after installation. Comply with SMACNA's "IAQ Guidelines for Occupied Buildings under Construction," Appendix G, "Duct Cleanliness for New Construction Guidelines."

M. Elbows: Use long-radius elbows wherever they fit. Fabricate 90-degree rectangular mitered elbows to include turning vanes, and 90-degree round elbows with a minimum of three segments for **12 inches** and smaller and a minimum of five segments for **14**

inches and larger.

N. Branch Connections: Use lateral or conical branch connections.

O. Install fibrous-glass ducts and fittings to comply with SMACNA's "Fibrous Glass Duct Construction Standards."

P. Install phenolic-foam ducts and fittings to comply with SMACNA's "Phenolic Duct Construction Standards."

Q. Install thermoset FRP ducts and fittings to comply with SMACNA's "Thermoset FRP Duct Construction Manual."

R. Install PVC ducts and fittings to comply with SMACNA's "Thermoplastic Duct (PVC) Construction Manual."

S. Install CPVC ducts and fittings to comply with SMACNA's "Thermoplastic Duct (PVC) Construction Manual."

T. Install HDPE ducts, fittings, and components to comply with manufacturer's written installation instructions. Installer to complete manufacturer's installation training prior to installation.

3.2 INSTALLATION OF HANGERS AND SUPPORTS

A. Install hangers and supports for fibrous-glass ducts and fittings to comply with SMACNA's "Fibrous Glass Duct Construction Standards," Ch. 6, "Hangers and Supports."

B. Install hangers and supports for phenolic-foam ducts and fittings to comply with SMACNA's "Phenolic Duct Construction Standards" Ch. 6, "Hangers and Supports" and with manufacturer's written instructions.

C. Install hangers and supports for thermoset FRP ducts and fittings to comply with SMACNA's "Thermoset FRP Duct Construction Manual," Ch. 7, "Requirements."

D. Install hangers and supports for PVC ducts and fittings to comply with SMACNA's "Thermoplastic Duct (PVC) Construction Manual," Ch. 3, "Standards of Construction for PVC Duct Systems."

E. Install hangers and supports for CPVC ducts and fittings to comply with SMACNA's "Thermoplastic Duct (PVC) Construction Manual," Ch. 3, "Standards of Construction for PVC Duct Systems."

F. Building Attachments: Concrete inserts, powder-actuated fasteners, or structural-steel fasteners appropriate for construction materials to which hangers are being attached.

1. Install concrete inserts before placing concrete.
2. Install powder-actuated concrete fasteners after concrete is placed and completely cured.
3. Use powder-actuated concrete fasteners for standard-weight aggregate

concretes or for slabs more than **4 inches** thick.

4. Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes or for slabs less than **4 inches** thick.
5. Do not use powder-actuated concrete fasteners for seismic restraints.

G. Install attachments to structures. Select and size attachments with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

3.3 PAINTING

A. Paint interior of thermoset FRP ducts that are visible through registers and grilles and that do not have duct liner. Apply one coat of flat, black, acrylic or latex paint that is chemically compatible with duct material. Confirm compatibility information with paint manufacturer in writing. Oil-based paint is not recommended. Paint materials and application requirements are specified in Section 099123 "Interior Painting."

3.4 FIELD QUALITY CONTROL

A. Leakage Tests: Comply with SMACNA's "HVAC Air Duct Leakage Test Manual." Submit a test report for each test. Where static pressure and leakage values shown in subparagraphs below differ from those in the SMACNA "HVAC Air Duct Leakage Test Manual," the more stringent values are to apply. Test the following systems:

1. Ducts with a Pressure Rating Higher than 3-Inch wg (750 Pa): Test representative duct sections totaling no less than 25 percent of total installed duct area for each designated pressure class.
2. Supply Ducts: For pressure rating of 3-Inch wg or higher; test representative duct sections totaling no less than 50 percent of total installed duct area for each designated pressure rating.
3. Return Ducts: For a pressure rating of 2-Inch wg or higher; test representative duct sections totaling no less than 50 percent of total installed duct area for each designated pressure rating.
4. Exhaust Ducts: For a pressure rating of 2-Inch wg or higher; test representative duct sections totaling no less than 50 percent of total installed duct area for each designated pressure rating.
5. Outdoor Air Ducts: For a pressure rating of 2-Inch wg or higher; test representative duct sections totaling no less than 50 percent of total installed duct area for each designated pressure rating.
6. Disassemble, reassemble, and seal segments of systems to accommodate leakage testing and for compliance with test requirements.
7. Test for leaks and repair before applying external insulation.
8. Conduct tests at static pressures equal to maximum design pressure of system or section being tested. If static-pressure ratings are not indicated, test entire system at maximum system design pressure. Do not pressurize systems above maximum design operating pressure.
9. Give seven days' advance notice for testing.

B. Duct System Cleanliness Test Procedure:

1. Visually inspect duct system to ensure that no visible contaminants are present.
2. Perform tests in accordance with NADCA ACR, Section 5 - "Cleanliness Verification and Documentation."
3. Test sections of fibrous-glass duct system chosen randomly by Owner for cleanliness in accordance with "Method 2 Protocol."
4. Test sections of HDPE duct systems chosen randomly by Owner, for cleanliness in accordance with Method 3 - "NADCA Vacuum Test."
5. Acceptable Cleanliness Level: Net weight of debris collected on the filter media not to exceed 0.75 mg/100 sq. cm.
6. Duct system will be considered defective if it does not pass tests and inspections.
7. Prepare test and inspection reports.

3.5 DUCT CLEANING

A. Clean duct system(s) before testing, adjusting, and balancing.

B. For cleaning of existing ductwork, see Section 230130.52 "Existing HVAC Air Distribution System Cleaning."

C. Use duct cleaning methodology as indicated in NADCA ACR.

D. Use service openings for entry and inspection.

1. Provide openings with access panels appropriate for duct static-pressure rating where required for cleaning access. Provide insulated panels for insulated or lined duct. Patch duct as recommended by duct manufacturer. Comply with Section 233300 "Air Duct Accessories" for access panels and doors.
2. Disconnect and reconnect flexible ducts as needed for cleaning and inspection.
3. Remove and reinstall ceiling as needed to gain access during the cleaning process.

E. Particulate Collection and Odor Control:

1. When venting vacuuming system inside the building, use HEPA filtration with minimum 99.97 percent collection efficiency for 0.3-micron (or larger) particles.
2. When venting vacuuming system to outdoors, use filter to collect debris removed from HVAC system, and locate exhaust downwind and away from air intakes and other points of entry into building.

F. Cleaning: Clean the following components by removing surface contaminants and deposits:

1. Air outlets and inlets (registers, grilles, and diffusers).
2. Supply, return, and exhaust fans including fan housings, plenums (except ceiling supply and return plenums), scrolls, blades or vanes, shafts, baffles, dampers, and drive assemblies.
3. Air-handling unit internal surfaces and components including mixing box, coil section, air wash systems, spray eliminators, condensate drain pans, humidifiers and dehumidifiers, filters and filter sections, and condensate collectors and drains.

4. Coils and related components.
5. Return-air ducts, dampers, actuators, and turning vanes except in ceiling plenums and mechanical equipment rooms.
6. Supply-air ducts, dampers, actuators, and turning vanes.
7. Dedicated exhaust and ventilation components and makeup air systems.

G. Mechanical Cleaning Methodology:

1. Operate vacuum-collection devices continuously during cleaning. Connect vacuum device to downstream end of duct sections so areas being cleaned are under negative pressure.
2. Mechanically agitate duct to dislodge debris adhered to interior duct surfaces without damaging integrity of ducts or duct accessories.
3. Clean fibrous-glass duct with HEPA vacuuming equipment; do not permit duct to get wet. Replace fibrous-glass duct that is damaged, deteriorated, or delaminated or that has friable material, mold, or fungus growth.
4. Clean coils and coil drain pans in accordance with NADCA 1992. Keep drain pan operational. Rinse coils with clean water to remove latent residues and cleaning materials; comb and straighten fins.
5. Provide drainage and cleanup for washdown procedures.
6. Antimicrobial Agents and Coatings: Apply EPA-registered antimicrobial agents if fungus is present. Apply antimicrobial agents in accordance with manufacturer's written instructions after removing surface deposits and debris.

3.6 DUCT APPLICATION SCHEDULE

A. Indoor Ducts and Fittings:

1. Fibrous-Glass Duct and Fittings:

a. Shape: Rectangular.
b. Minimum Flexural Rigidity: EI- 800.
c. Minimum Board Thickness: 2 inches.

2. Phenolic-Foam Duct and Fittings:

a. Shape: Rectangular.
b. Minimum Panel Thickness: 7/8 inch.
c. Aluminum Cladding: Minimum **0.025 inch** thick.
d. Joints: Secure joints with adhesive or clips in accordance with duct manufacturer's written instructions, then tape joints with aluminum tape.
e. Sealing: Seal all joints with a generous and continuous bead of silicone sealant and press into corners using a smooth radius tool.

B. Outdoor Duct and Fittings: Provide suitable external surface protection as recommended by manufacturer.

1. Phenolic-Foam Duct and Fittings:

a. Shape: Rectangular.

b. Minimum Panel Thickness: 7/8 inch.
c. Aluminum Cladding: Minimum **0.032 inch** thick.
d. Joints: Secure joints with adhesive or clips in accordance with duct manufacturer's written instructions, then tape joints with aluminum tape.
e. Sealing: Seal all joints with a continuous bead of silicone sealant and press into corners using a smooth radius tool.

2. Thermoset FRP Duct and Fittings:

a. Shape: Round.
b. Double-Wall Insulated Ducts: Minimum 1-inch insulation thickness with thermal conductivity factor of 14 insulation thickness.

C. Underground Ducts: Provide suitable external surface protection where recommended in writing by manufacturer.

1. Thermoset FRP Duct and Fittings:

a. Shape: Round.
b. Double wall.
c. Insulation Thickness: 1 inch.
d. Drain: Minimum **NPS 1** PVC pipe with P-trap to air-gap drain.

2. PVC Duct and Fittings:

a. Shape: Round.
b. Drain: Minimum **NPS 1** PVC pipe with P-trap to air-gap drain.

3. CPVC Duct and Fittings:

a. Shape: Round.
b. Drain: Minimum **NPS 1** CPVC pipe with P-trap to air-gap drain.

4. HDPE Duct and Fittings:

a. Shape: Round.
b. Drain as recommended by manufacturer.

D. Fume Exhaust: Thermoset FRP duct and fittings.

1. Install exhaust ducts without dips and traps that can hold liquid, and slope duct a minimum of 2 percent to drain. Where indicated on the Drawings, install trapped drain piping sloped 2 percent to drain.
2. Connect duct to fume hood or other equipment where indicated on the Drawings.

END OF SECTION 23 31 16

SECTION 233533 - LISTED KITCHEN VENTILATION SYSTEM EXHAUST DUCTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. UL-listed, factory-fabricated grease duct - double wall, reduced clearance.
2. UL-listed, factory-fabricated grease duct - single wall.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for UL-listed grease ducts.

B. Shop Drawings: For UL-listed, factory-fabricated grease ducts.

1. Plans, elevations, sections, and attachment details.
2. Details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
3. Details of fabrication and assembly of hangers and seismic restraints.

1.3 INFORMATIONAL SUBMITTALS

A. Welding certificates.

1.4 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel in accordance with the following welding codes:

1. AWS D1.1/D1.1M.
2. AWS D9.1/D9.1M.

PART 2 - PRODUCTS

2.1 UL-LISTED, FACTORY-FABRICATED GREASE DUCT - SINGLE WALL

A. Manufacturers: Subject to compliance with requirements, provide products by the following:

1. Ampco Stacks; DuraVent
2. DuraVent
3. Jeremias Inc.
4. Metal-Fab, Inc
5. Schebler Co. (The)
6. Security Chimneys; DuraVent
7. Selkirk Corporation; DuraVent
8. Van-Packer Co.
9. Ventilation Direct

B. Description: Factory-fabricated, UL-listed and -labeled, single-wall duct system tested in accordance with UL 1978 and rated for **500 deg F** continuously, or **2000 deg F** for 30 minutes; with positive or negative duct pressure and complying with NFPA 96.

C. Construction: Wall constructed of ASTM A666, Type 304 stainless steel.

D. Gaskets and Flanges: Ensure that gaskets and sealing materials are rated at **1500 deg F** minimum.

E. Hood Connectors: Constructed from same material as grease duct with internal or external continuously welded or brazed joints.

F. Accessories: Tees, elbows, increasers, terminations, adjustable roof flashings, storm collars, support assemblies, thimbles, firestop spacers, and fasteners; fabricated from similar materials and designs as vent-pipe straight sections; all listed for same assembly. Include unique components required to comply with NFPA 96 including cleanouts, transitions, adapters, and drain fittings.

G. Grease Duct Access Doors: Provide access doors where indicated and where necessary for cleaning and inspection of duct interior.

1. Description: Factory-fabricated, -listed, and -labeled, personnel and maintenance access doors tested in accordance with UL 1978 and rated for **500 deg F** continuously, or **2000 deg F** for 30 minutes; with positive or negative duct pressure and complying with NFPA 96.
2. Construction: 0.0625 inch No. 16 MSG Type 304 stainless steel inner shell and aluminized-steel outer cover with two handles.
3. Fasteners: Stainless steel bolts and wing nuts.

    a. Ensure that bolts do not penetrate interior of duct space.

4. Maintenance Access Door Minimum Dimensions: 7 by 7 inches.
5. Personnel Access Door Minimum Dimensions: 22 by 20 inches.
6. Door Label: Mark door with uppercase lettering as follows: "ACCESS PANEL. DO NOT OBSTRUCT."

PART 3 - EXECUTION

3.1 INSTALLATION OF LISTED KITCHEN VENTILATION SYSTEM EXHAUST DUCTS

A. Coordinate installation of roof curbs, equipment supports, and roof penetrations. Comply with requirements in Section 077200 "Roof Accessories."

B. Coordinate connections to kitchen exhaust hoods with requirements in Section 233813 "Commercial-Kitchen Hoods."

C. Coordinate connections to exhaust fans with requirements in Section 233400 "HVAC Fans."

D. Coordinate firestopping where grease ducts penetrate fire separations with requirements in Section 078413 "Penetration Firestopping."

E. Comply with all installation requirements of NFPA 96, all applicable codes, and authorities having jurisdiction.

F. Comply with minimum clearances from combustibles and minimum termination heights in accordance with product listing or NFPA 96 and UL 2221, whichever is most stringent.

G. Install airtight personnel and maintenance access doors where indicated.

H. Seal between sections of grease exhaust ducts in accordance with manufacturer's written installation instructions; use sealants recommended in writing by manufacturer.

I. Grease Duct Supports: Construct duct bracing and supports from noncombustible material.

1. Design bracing and supports to carry static and seismic loads within stress limitations of the Florida Building Code and NFPA 96.
2. Ensure that bolts, screws, rivets, and other mechanical fasteners do not penetrate duct walls.

J. Connections: Make grease duct connections in accordance with requirements of applicable codes and authorities having jurisdiction.

1. Grease Duct to Exhaust Fan Connections: Connect grease ducts to inlet side of fan using flanges, gaskets, and bolts.
2. Grease Duct to Hood Connections:

    a. Make grease duct to hood joints connections using internal or external continuously welded or brazed joints.
    b. Make watertight grease duct to hood joints connections using flanges, gaskets, and bolts.

K. Support ducts at intervals recommended by manufacturer to support weight of ducts and accessories, without applying loading on kitchen hoods.

1. Securely attach supports and bracing to structure.
2. Where grease ducts and access doors are large enough for service personnel to enter, provide sufficient structural support to accommodate additional load.

L. Grease Duct Enclosures: Comply with requirements of all applicable codes and authorities having jurisdiction.

M. Coordinate fire-rated enclosure construction with Section 092116.23 "Gypsum Board Shaft Wall Assemblies."

N. Repair damage to adjacent materials caused by installation of listed kitchen ventilation system exhaust ducts.

3.2 FIELD QUALITY CONTROL

A. Perform air leakage test in presence of Owner's Representative before concealment of any portion of grease duct system.

END OF SECTION 23 35 33

SECTION 23 37 13.23 - REGISTERS AND GRILLES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Registers - adjustable-blade face.
2. Registers - fixed-blade face.
3. Grilles - adjustable-blade face.
4. Grilles - fixed-blade face.

B. Related Requirements:

1. Section 233300 "Air Duct Accessories" for fire and smoke dampers and volume-control dampers not integral to registers and grilles.
2. Section 233713.13 "Air Diffusers" for various types of air diffusers.
3. Section 233713.43 "Security Registers and Grilles" for security registers and security grilles.
4. Section 233716 "Fabric Air-Diffusion Devices" for continuous tubular diffusers.

1.2 ACTION SUBMITTALS

A. Product Data:

1. For each type of product.

a. Data Sheet: Indicate materials of construction, finish, and mounting details; and performance data including throw and drop, static-pressure drop, and noise ratings.
b. Register and Grille Schedule: Indicate drawing designation, room location, quantity, model number, size, and accessories furnished.

B. Samples: For each exposed product and for each color and texture specified. Smallest size register and grille indicated.

C. Samples for Initial Selection: For registers and grilles with factory-applied color finishes. Actual size of smallest register and grille indicated.

D. Samples for Verification: For registers and grilles, in manufacturer's standard sizes to verify color selected. Actual size of smallest size register and grille indicated.

1.3 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the

items involved:

1. Ceiling suspension assembly members.
2. Method of attaching hangers to building structure.
3. Size and location of initial access modules for acoustical tile.
4. Ceiling-mounted items, including lighting fixtures, diffusers, grilles, speakers, sprinklers, access panels, and special moldings.
5. Duct access panels.

B. Source quality-control reports.

PART 2 - PRODUCTS

2.1 REGISTERS

A. Registers - Adjustable-Blade Face:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

    a. Carnes Company
    b. Hart & Cooley, LLC
    c. Krueger-HVAC; brand of Johnson Controls International plc, Global Products
    d. Price Industries Limited
    e. Titus; brand of Johnson Controls International plc, Global Products
    f. Tuttle & Bailey; brand of Johnson Controls International plc, Global Products

2. Material: Aluminum.
3. Finish: Baked enamel, white.
4. Face-Blade Arrangement: Face blades with adjustable angle to permit manual adjustment of air discharge direction. Blades vertically spaced 3/4 inch apart.
5. Core Construction: Integral.
6. Rear-Blade Arrangement: Rear blades with adjustable angle to permit manual adjustment of air discharge direction. Blades horizontally spaced 3/4 inch apart.
7. Frame: 1 inch wide.
8. Mounting: Countersunk screw.
9. Accessories:

    a. Damper Type: NRTL listed, opposed blade, spring closing, and with fusible link for 160 deg F.
    b. Front -blade gang operator.
    c. Filter.

B. Registers - Fixed-Blade Face:

1. Manufacturers: Subject to compliance with requirements, available

manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Carnes Company
b. Hart & Cooley, LLC
c. Krueger-HVAC; brand of Johnson Controls International plc, Global Products
d. Price Industries Limited
e. Titus; brand of Johnson Controls International plc, Global Products
f. Tuttle & Bailey; brand of Johnson Controls International plc, Global Products

2. Material: Aluminum.
3. Finish: Baked enamel, white.
4. Face-Blade Arrangement: Fixed-position face blades, horizontally spaced 3/4 inch apart.
5. Core Construction: Integral.
6. Frame: 1 inch wide.
7. Mounting: Countersunk screw.
8. Damper Type: NRTL listed, opposed blade, spring closing, and with fusible link for 160 deg F.
9. Accessory: Filter.

2.2 GRILLES

A. Grilles - Adjustable-Blade Face:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Carnes Company
b. Hart & Cooley, LLC
c. Krueger-HVAC; brand of Johnson Controls International plc, Global Products
d. Price Industries Limited
e. Titus; brand of Johnson Controls International plc, Global Products
f. Tuttle & Bailey; brand of Johnson Controls International plc, Global Products

2. Material: Aluminum.
3. Finish: Baked enamel, white.
4. Face-Blade Arrangement: Face blades with adjustable angle to permit manual adjustment of discharge direction. Blades horizontally spaced 3/4 inch apart.
5. Core Construction: Integral.
6. Rear-Blade Arrangement: All rear blades with adjustable angle to permit manual adjustment of air-discharge direction. Blades vertically spaced 3/4 inch apart.
7. Frame: 1 inch wide.
8. Mounting: Countersunk screw.
9. Accessories:

a. Damper: Opposed blade, spring closing, and with NRTL listed fusible link for **160 deg F**.
b. Front -blade gang operator.
c. Filter.

B. Grilles - Fixed-Blade Face:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Carnes Company
b. Hart & Cooley, LLC
c. Krueger-HVAC; brand of Johnson Controls International plc, Global Products
d. Price Industries Limited
e. Titus; brand of Johnson Controls International plc, Global Products
f. Tuttle & Bailey; brand of Johnson Controls International plc, Global Products

2. Material: Aluminum.
3. Finish: Baked enamel, white.
4. Face-Blade Arrangement: Fixed-face blade position, horizontally spaced 3/4 inch apart.
5. Core Construction: Integral.
6. Frame: 1 inch wide.
7. Mounting: Countersunk screw.
8. Accessory: Filter.

2.3 SOURCE QUALITY CONTROL

A. Verification of Performance: Rate registers and grilles in accordance with ASHRAE 70.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas where registers and grilles are installed for compliance with requirements for installation tolerances and other conditions affecting performance of equipment.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION OF REGISTERS AND GRILLES

A. Install registers and grilles level and plumb.

B. Outlets and Inlets Locations: Drawings indicate general arrangement of ducts, fittings,

and accessories. Air outlet and inlet locations have been indicated to achieve design requirements for air volume, noise criteria, airflow pattern, throw, and pressure drop. Make final locations where indicated. For units installed in lay-in ceiling panels, locate units in the center of panel. Where architectural features or other items conflict with installation, notify Architect for a determination of final location.

C. Install registers and grilles with airtight connections to ducts and to allow service and maintenance of dampers, air extractors, and fire dampers.

3.3 ADJUSTING

A. After installation, adjust registers and grilles to air patterns indicated, or as directed, before starting air balancing.

END OF SECTION 23 37 13.23

SECTION 23 38 13 - COMMERCIAL-KITCHEN HOODS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Commercial-kitchen hoods, Type I.
2. Commercial-kitchen hoods, Type II.

B. Related Requirements:

1. Section 233533 "Listed Kitchen Ventilation System Exhaust Ducts" for fire-rated ducts connecting to kitchen hoods.

1.2 DEFINITIONS

A. Listed Hood: A hood, factory fabricated and tested for compliance with UL 710 by a testing agency acceptable to authorities having jurisdiction.

B. Standard Hood: A hood, usually field fabricated, that complies with design, construction, and performance criteria of applicable national and local codes.

C. Type I Hood: A hood designed for grease exhaust applications.

D. Type II Hood: A hood designed for heat and steam removal and for other nongrease applications.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Required Attendance:

a. Mechanical contractor.
b. Kitchen equipment supplier
c. General contractor.

1.4 ACTION SUBMITTALS

A. Product Data: For the following:

1. Standard hoods.
2. Filters/baffles.
3. Fire-suppression systems.

4. Luminaires.

B. Shop Drawings: Signed and sealed by a qualified professional engineer.

1. Shop Drawing Scale: 1/4 inch = 1 foot.
2. Show plan view, elevation view, sections, roughing-in dimensions, service requirements, duct connection sizes, and attachments to other work.
3. Show cooking equipment plan and elevation to confirm minimum code-required overhang.
4. Indicate performance, exhaust and makeup air airflow, and pressure loss at actual Project-site elevation.
5. Show water-supply and drain piping connections.
6. Show control cabinets.
7. Show fire-protection cylinders, piping, actuation devices, and manual control devices.
8. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
9. Design Calculations: Calculate requirements for selecting seismic restraints.
10. Include diagrams for power, signal, and control wiring.
11. Duct Connections: Detail connections between ducts and hoods, including access doors and panels.
12. Piping Diagrams: Detail fire-suppression piping and components and differentiate between manufacturer-installed and field-installed piping. Include roughing-in requirements for drain connections. Show cooking equipment plan and elevation to illustrate fire-suppression nozzle locations.

    a. Piping Diagram Scale: 1/4 inch = 1 foot.

1.5 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:

1. Coordination Drawing Scale: 1/4 inch = 1 foot.
2. Suspended ceiling assembly components.
3. Structural members to which equipment will be attached.
4. Roof framing and support members for duct penetrations.
5. Items penetrating finished ceiling including the following:

    a. Luminaires.
    b. Air outlets and inlets.
    c. Speakers.
    d. Sprinklers.
    e. Access panels.
    f. Moldings on hoods and accessory equipment.

B. Welding certificates.

C. Seismic Qualification Data: Submit certification that commercial-kitchen hoods, accessories, and components will withstand seismic forces defined in Section 230548 "Vibration and Seismic Controls for HVAC." Include the following:

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.

a. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified ."

2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

D. Field quality-control reports.

1.6 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Grease Filters/Baffles: One complete set(s).

1.7 QUALITY ASSURANCE

A. Engineering Responsibility: Preparation of Shop Drawings and comprehensive engineering analysis by a qualified professional engineer.

B. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D 1.1M, "Structural Welding Code - Steel," for hangers and supports; and AWS D9.1/D9.1M, "Sheet Metal Welding Code," for joint and seam welding.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.2 HOOD MATERIALS

A. Stainless-Steel Sheet: ASTM A666, Type 304.

1. Minimum Thickness: 0.037 inch.

2. Finish: Comply with SSINA's "Finishes for Stainless Steel" for recommendations for applying and designating finishes.

    a. Finish shall be free from tool and die marks and stretch lines and shall have uniform, directionally textured, polished finish indicated, free of cross scratches. Grain shall run with long dimension of each piece.

3. Concealed Stainless-Steel Surfaces: ASTM A480/A480M, No. 2B finish (bright, cold-rolled, unpolished finish).
4. Exposed Surfaces: ASTM A480/A480M, No. 3 finish (intermediate polished surface).
5. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.

B. Carbon-Steel Sheets: ASTM A1008/A1008M, cold-rolled sheets; commercial quality; with oiled, exposed matte finish.

1. Minimum Thickness: 0.043 inch.

C. Galvanized-Steel Sheet: Lock-forming quality; ASTM A653/A653M, **G90** coating designation.

1. Minimum Thickness: 0.052 inch.

D. Zinc-Coated Steel Shapes: ASTM A36/A36M, zinc coated according to ASTM A123/A123M requirements.

E. Sealant: ASTM C920; Type S, Grade NS, Class 25, Use NT. Elastomeric sealant shall be NSF certified for commercial-kitchen hood application. Sealants, when cured and washed, shall comply with requirements in 21 CFR 177.2600, for use in areas that come in contact with food.

1. Color: As selected by Architect from manufacturer's full range.
2. Backer Rod: Closed-cell polyethylene, in diameter larger than joint width.

F. Sound Dampening: NSF-certified, non-absorbent, hard-drying, sound-deadening compound for permanent adhesion to metal in minimum **1/8-inch** thickness that does not chip, flake, or blister.

G. Gaskets: NSF certified for end-use application indicated; of resilient rubber, neoprene, or PVC that is nontoxic, stable, odorless, nonabsorbent, and unaffected by exposure to foods and cleaning compounds, and that passes testing according to UL 710.

2.3 GENERAL HOOD FABRICATION REQUIREMENTS

A. Welding: Use welding rod of same composition as metal being welded. Use methods that minimize distortion and develop strength and corrosion resistance of base metal. Make ductile welds free of mechanical imperfections such as gas holes, pits, or cracks.

1. Welded Butt Joints: Full-penetration welds for full-joint length. Make joints flat,

continuous, and homogenous with sheet metal without relying on straps under seams, filling in with solder, or spot welding.

2. Grind exposed welded joints flush with adjoining material and polish to match adjoining surfaces.
3. Where fasteners are welded to underside of equipment, finish reverse side of weld smooth and flush.
4. Coat concealed stainless-steel welded joints with metallic-based paint to prevent corrosion.
5. After zinc-coated steel is welded, clean welds and abraded areas and apply SSPC-Paint 20, high-zinc-dust-content, galvanizing repair paint to comply with ASTM A780/A780M.

B. For metal butt joints, comply with SMACNA's "Kitchen Ventilation Systems & Food Service Equipment Guidelines."

C. Where stainless steel is joined to a dissimilar metal, use stainless-steel welding material or fastening devices.

D. Form metal with break bends that are not flaky, scaly, or cracked in appearance; where breaks mar uniform surface appearance of material, remove marks by grinding, polishing, and finishing.

E. Sheared Metal Edges: Finish free of burrs, fins, and irregular projections.

F. In food zones, as defined in NSF, fabricate surfaces free from exposed fasteners.

G. Cap exposed fastener threads, including those inside cabinets, with stainless-steel lock washers and stainless-steel cap (acorn) nuts.

H. Fabricate pipe slots on equipment with turned-up edges sized to accommodate service and utility lines and mechanical connections.

I. Fabricate enclosures, including panels, housings, and skirts, to conceal service lines, operating components, and mechanical and electrical devices including those inside cabinets unless otherwise indicated.

J. Fabricate seismic restraints according to SMACNA's "Kitchen Ventilation Systems & Food Service Equipment Guidelines," Appendix A, "Seismic Restraint Details."

K. Fabricate equipment edges and backsplashes according to SMACNA's "Kitchen Ventilation Systems & Food Service Equipment Guidelines."

L. Fabricate enclosure panels to ceiling and wall as follows:

1. Fabricate panels on all exposed side(s) with same material as hood, and extend from ceiling to top of hood canopy and from canopy to wall.
2. Wall Offset Spacer: Minimum of **3 inches**.
3. Wall Shelves and Overshelves: Fabricate according to SMACNA's "Kitchen Ventilation Systems & Food Service Equipment Guidelines," with minimum **0.0625-inch-** thick, stainless-steel shelf tops.

2.4 EXHAUST HOOD FABRICATION, TYPE I HOOD

A. Exhaust Hood Fabricators, Type I Hood:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

    a. CaptiveAire Systems
    b. Greenheck Fan Corporation

B. Weld all joints exposed to grease with continuous welds, and make filters/baffles or grease extractors and makeup air diffusers easily accessible for cleaning.

1. Fabricate hoods according to NSF 2, "Food Equipment."
2. Hoods shall be listed and labeled, according to UL 710, by a testing agency acceptable to authorities having jurisdiction.
3. Hoods shall be designed, fabricated, and installed according to NFPA 96.
4. Include access panels as required for access to fire dampers and fusible links.
5. Duct Collars: Minimum **0.0598-inch-** thick steel at least **3 inches** long, continuously welded to top of hood and at corners. Fabricate a collar with a 0.5-inch- wide duct flange.
6. Duct-Collar Fire Dampers: Collar and damper shall comply with UL 710 testing and listing required for the entire hood.

    a. Collar: Minimum **0.0598-inch-** thick stainless steel, at least **3 inches** long, continuously welded to top of hood and at corners. Fabricate a collar with a minimum 0.5-inch- wide duct flange.
    b. Blades: Minimum **0.1046-inch-** thick stainless steel, counterbalanced to remain closed after actuation.
    c. Blade Pivot and Spring: Stainless steel.
    d. Fusible Link: Replaceable, **212 deg F** rated.

7. Makeup Air Fire Dampers: Labeled, according to UL 555, by a testing agency acceptable to authorities having jurisdiction.

    a. Fire Rating: 1-1/2 hours.
    b. Frame: SMACNA Type A, with blades in airstream; fabricated with roll-formed, galvanized steel; with mitered and interlocking corners.
    c. Blades: Roll-formed, interlocking or folded, minimum **0.034-inch-** thick, galvanized-steel sheet.
    d. Horizontal Dampers: Include a blade lock and stainless-steel closure spring.
    e. Fusible Link: Replaceable, 165 deg F rated.

C. Hood Configuration: Exhaust and makeup air.

1. Makeup air shall be introduced by combination of induction and diffusion inside canopy. If makeup air is not heated, insulate interior of makeup air plenum with high-density insulation having maximum flame-spread and smoke-developed indexes of 25 and 50, respectively.

2. Makeup air shall be introduced through bottom of canopy through perforated diffusers.
3. Makeup air shall be introduced through laminar-flow-type, perforated metal panels on front of hood canopy.
4. Makeup air shall be introduced through laminar-flow-type, perforated metal diffusers mounted in the ceiling in front of hood canopy. Furnish laminar-flow-type diffusers with baked white enamel finish and volume-control dampers.
5. Makeup air shall be introduced through plenum at rear of hood, extending down below appliance cooking surfaces.

D. Hood Style: Wall-mounted canopy.

E. Filters/Baffles: Removable, stainless-steel. Fabricate stainless steel for filter frame and removable collection cup and pitched trough. Exposed surfaces shall be pitched to drain to collection cup. Filters/baffles shall be tested according to UL 1046, "Safety for Grease Filters for Exhaust Ducts," by an NRTL acceptable to authorities having jurisdiction.

F. Removable Water-Wash Grease Extractor: Stainless steel, tested with hood according to UL 710.

G. Stationary Water-Wash Grease Extractor: Integral, automatically self-cleaning, spraying hot water and detergent over the entire length of exhaust plenum. Fabricate to supply **140 deg F** water at **1.25 gpm/ft.** of hood length, at **40- to 60-psig** inlet pressure.

1. Water Piping: ASTM A270/A270M, Type 304 stainless steel.
2. Fabricate to drain water and detergent to a collection trough having stainless-steel drain fittings.
3. Single, hood -mounting control panel with a solid-state, programmable controller shall control all hoods on Project. Wash cycle shall be factory set to operate for 10 minutes after fans stop.
4. Detergent shall be supplied by an adjustable-flow, 120-V ac injection pump from a reservoir with a minimum capacity of **2.5 gal.**.

H. Water-mist option shall supply a maximum of **0.1 gpm/ft.** of hood length through stainless-steel piping and nozzles.

1. Water Piping: ASTM A270/A270M, Type 304 stainless steel.

I. Luminaires: Surface-mounted, LED luminaires and lamps with lenses sealed vapor tight. Wiring shall be in conduit on hood exterior. Number and location of luminaires shall provide a minimum of **70 fc** at **30 inches** above finished floor.

1. Light switches shall be mounted on front panel of hood canopy.
2. Luminaires: LED complying with UL 1598.

J. Comply with hood control requirements in Section 230923 "Direct Digital Control (DDC) System for HVAC" and Section 230993.11 "Sequence of Operations for HVAC DDC."

K. Hood Controls: Hood -mounting control cabinet, factory wired to control groups of

adjacent hoods, and fabricated of stainless steel.

1. Exhaust Fan: On-off switches shall start and stop the exhaust fan. Interlock exhaust fan with makeup air supply fan to operate simultaneously. Interlock exhaust fan with fire-suppression system to operate fan(s) during fire-suppression-agent release and to remain in operation until manually stopped. Include red pilot light to indicate fan operation.

    a. Exhaust Fan Motor Starter: Comply with Section 262913.03 "Manual and Magnetic Motor Controllers."

2. Exhaust Fan Interlock: Factory wire the exhaust fan starters in a single control cabinet for adjacent hoods to operate together.
3. Photocell and Temperature Control, Cycling: Cycle makeup air and exhaust-air fans on and off, based on temperature at hood discharge and opacity of smoke in hood. Interlock fan control with fire-suppression system to operate during fire-suppression-agent release and to remain in operation until manually stopped. Provide air-purge fan and conduit to photocell and reflector to avoid grease accumulation that will negatively affect performance of system.
4. Photocell and Temperature Control, Two Speed: Change speed (off, low, and high) of makeup air and exhaust-air fans with speed switch, based on temperature at hood discharge and opacity of smoke in hood. Interlock fan control with fire-suppression system to operate at high speed during fire-suppression-agent release and to remain in high-speed operation until manually stopped. Provide air-purge fan and conduit to photocell and reflector to avoid grease accumulation that will negatively affect performance of system. Controller shall limit exhaust-duct velocity between minimum velocity and maximum velocity. Controller shall limit supply quantity to minimum quantity for proper operation of makeup air unit.
5. Photocell and Temperature Control, Variable Speed: Vary speed of makeup air and exhaust-air fans with variable-frequency controllers, based on temperature at hood discharge and opacity of smoke in hood. Interlock fan control with fire-suppression system to operate at high speed during fire-suppression-agent release and to remain in high-speed operation until manually stopped. Provide air-purge fan and conduit to photocell and reflector to avoid grease accumulation that will negatively affect performance of system. Controller shall limit exhaust-duct velocity between minimum velocity and maximum velocity. Controller shall limit supply quantity to minimum quantity for proper operation of makeup air unit.
6. High-Temperature Control: Alarm shall sound and cooking equipment shall shut down before hood discharge temperature rises to actuation temperature of fire-suppression system.
7. Water Mist: Solenoid valve interlocked with exhaust fan to open with hood operation.

L. Capacities and Characteristics: see drawings.

2.5 FIRE-SUPPRESSION SYSTEM, WET CHEMICAL

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to,

the following:

1. Ansul; brand of Johnson Controls International plc, Building Solutions North America
2. Kidde; Carrier Global Corporation

B. Description: Engineered distribution piping designed for automatic detection and release or manual release of fire-suppression agent by hood operator. Fire-suppression system shall be listed and labeled for complying with NFPA 17A, "Wet Chemical Extinguishing Systems," by a qualified testing agency acceptable to authorities having jurisdiction.

1. Steel Pipe, **NPS 2** and Smaller: ASTM A53/A53M, Type S, Grade A, Schedule 40, plain ends.
2. Malleable-Iron Threaded Fittings: ASME B16.3, Classes 150 and 300.
3. Piping, fusible links and release mechanism, tank containing the suppression agent, and controls shall be factory installed. Controls shall be in stainless-steel control cabinet mounted on hood or wall. Furnish manual pull station for wall mounting. Exposed piping shall be covered with chrome-plated aluminum tubing. Exposed fittings shall be chrome plated.
4. Liquid Extinguishing Agent: Noncorrosive, low-pH liquid.
5. Furnish electric-operated gas shutoff valve with clearly marked open and closed indicator for field installation.
6. Fire-suppression system controls shall be integrated with controls for fans, lights, and fuel supply and located in a single cabinet for each group of hoods immediately adjacent.
7. Wiring shall have color-coded, numbered terminal blocks and grounding bar. Spare terminals for fire alarm, optional wiring to start fan with fire alarm, red pilot light to indicate fan operation, and control switches shall all be factory wired in control cabinet with relays or starters. Include spare terminals for fire alarm, and wiring to start fan with fire alarm.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine roughing-in for piping systems to verify actual locations of piping connections before equipment installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

A. Coordinate equipment layout and installation with adjacent Work, including luminaires,

HVAC equipment, plumbing, and fire-suppression system components.

B. Complete field assembly of hoods where required.

1. Make closed butt and contact joints that do not require filler.
2. Grind field welds on stainless-steel equipment smooth, and polish to match adjacent finish. Comply with welding requirements in "General Hood Fabrication Requirements" Article.

C. Install hoods and associated services with clearances and access for maintaining, cleaning, and servicing hoods, filters/baffles, grease extractor, and fire-suppression systems according to manufacturer's written instructions and requirements of authorities having jurisdiction.

D. Make cutouts in hoods where required to run service lines and to make final connections, and seal openings according to UL 1978.

E. Securely anchor and attach items and accessories to walls, floors, or bases with stainless-steel fasteners unless otherwise indicated.

F. Install hoods to operate free from vibration.

G. Install seismic restraints according to SMACNA's "Kitchen Ventilation Systems & Food Service Equipment Guidelines," Appendix A, "Seismic Restraint Details."

H. Install trim strips and similar items requiring fasteners in a bed of sealant. Fasten with stainless-steel fasteners at **48 inches** o.c. maximum.

I. Install sealant in joints between equipment and abutting surfaces with continuous joint backing unless otherwise indicated. Provide airtight, watertight, vermin-proof, sanitary joints.

J. Install lamps, with maximum recommended wattage, in equipment with integral lighting.

K. Set initial temperatures, and calibrate sensors.

L. Set field-adjustable switches.

3.3 CONNECTIONS

A. Where installing piping adjacent to hoods, allow space for service and maintenance.

B. Install reduced-pressure backflow preventer on washer-water supply. Backflow preventer is specified in Section 221119 "Domestic Water Piping Specialties."

C. Install washer-water drain piping full size of hood connection to an adjacent floor drain or a floor sink.

D. Makeup Water Connection: Comply with applicable requirements for valves and accessories on piping connections to water-cooled units in Section 221119 "Domestic Water Piping Specialties."

E. Connect ducts according to requirements in Section 233300 "Air Duct Accessories." Install flexible connectors on makeup air supply duct. Weld exhaust-duct connections with continuous liquidtight joint.

F. Install fire-suppression piping for remote-mounted suppression systems according to NFPA 17A, "Wet Chemical Extinguishing Systems."

3.4 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

C. Perform the following tests and inspections with the assistance of a factory-authorized service representative:

1. Test each equipment item for proper operation. Repair or replace equipment that is defective, including units that operate below required capacity or that operate with excessive noise or vibration.
2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
3. Test water, drain, gas, and liquid-carrying components for leaks. Repair or replace leaking components.
4. Perform hood performance tests required by authorities having jurisdiction.
5. Perform fire-suppression system performance tests required by authorities having jurisdiction.

D. Commercial-kitchen hoods will be considered defective if they do not pass tests and inspections.

E. Prepare test and inspection reports.

3.5 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain commercial-kitchen hoods.

END OF SECTION 23 38 13

SECTION 237313.13 - INDOOR, BASIC AIR-HANDLING UNITS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Indoor, basic air-handling units.
2. Unit casings.
3. Fan, drive, and motor section.
4. Coil section.
5. Air filtration section.
6. Dampers.

1.2 ACTION SUBMITTALS

A. Product Data: For each air-handling unit.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
3. Include unit dimensions and weight.
4. Include cabinet material, metal thickness, finishes, insulation, and accessories.
5. Fans:

    a. Include certified fan-performance curves with system operating conditions indicated.
    b. Include certified fan-sound power ratings.
    c. Include fan construction and accessories.
    d. Include motor ratings, electrical characteristics, and motor accessories.

6. Include certified coil-performance ratings with system operating conditions indicated.
7. Include filters with performance characteristics.
8. Include dampers, including housings, linkages, and operators.

B. Sustainable Design Submittals:

1. Product Data: For air filtration performance.

C. Shop Drawings: For each type and configuration of indoor, basic, air-handling unit.

1. Include plans, elevations, sections, and mounting details.
2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.

3. Detail fabrication and assembly of indoor, basic air-handling units, as well as procedures and diagrams.
4. Include diagrams for power, signal, and control wiring.

D. Delegated Design Submittal: For vibration isolation , supports, indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1. Design Calculations: Calculate requirements for selecting vibration isolators , supports, and for designing vibration isolation bases.

1.3 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Floor plans and other details, or BIM model, drawn to scale, showing the items described in this Section, and coordinated with all building trades.

B. Seismic Qualification Data: Certificates for indoor, basic air-handling units, accessories, and components, from manufacturer.

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
4. Restraint of internal components.

C. Source quality-control reports.

D. Startup service reports.

E. Field quality-control reports.

F. Sample Warranty: For manufacturer's warranty.

1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For air-handling units to include in emergency, operation, and maintenance manuals.

1.5 WARRANTY

A. Warranty: Manufacturer agrees to repair or replace components of indoor, basic, air-handling units that fail in materials or workmanship within specified warranty period.

1. Warranty Period: Manufacturer's standard, but not less than one year(s) from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. NFPA Compliance: Comply with NFPA 90A for design, fabrication, and installation of air-handling units and components.

C. ASHRAE 62.1 Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and Startup."

D. ASHRAE/IES 90.1 Compliance: Applicable requirements in ASHRAE/IES 90.1, Section 6 - "Heating, Ventilating, and Air-Conditioning."

E. Structural Performance: Casing panels are to be self-supporting and capable of withstanding positive/negative 4-inch wg of internal static pressure, without exceeding a midpoint deflection of 0.005 inches/inch of panel span.

2.2 INDOOR, BASIC AIR-HANDLING UNITS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Carrier Global Corporation
2. Daikin Applied
3. Titus; brand of Johnson Controls International plc, Global Products
4. Trane
5. YORK; brand of Johnson Controls International plc, Building Solutions North America

B. Unit Casings:

1. General Fabrication Requirements for Casings:

a. Forming: Form walls, roofs, and floors with at least two breaks at each joint.
b. Joints: Sheet metal screws or pop rivets.
c. Sealing: Seal all joints with water-resistant sealant. Hermetically seal at each corner and around entire perimeter.
d. Base Rail:

1) Material: Galvanized steel.
2) Height: 4 inches.

2. Single-Wall Construction:

a. Material: Galvanized steel with manufacturer's standard finish.
b. Insulation and Adhesive:

1) Materials: ASTM C1071, Type I or Type II glass-fiber blanket or board insulation, neoprene coated or foil faced.
2) Insulation R-Value: Minimum 4.2.
3) Insulation Thickness: 1 inch.
4) Thermal Break: Provide continuity of insulation with no through-casing metal in casing walls, floors, or roofs of air-handling unit.
5) Location and Application: Factory applied with adhesive and mechanical fasteners to the internal surface of all complete unit.

a) Liner Adhesive: Comply with ASTM C916, Type I.
b) Mechanical Fasteners: Galvanized steel, suitable for adhesive attachment, or mechanical attachment, to duct without damaging liner when applied as recommended by manufacturer and without causing leakage in cabinet.

3. Airstream Surfaces: Surfaces in contact with airstream are to comply with requirements in ASHRAE 62.1.
4. Static-Pressure Classifications:

a. For Unit Sections Upstream of Fans: Minus 2-inch wg.
b. For Unit Sections Downstream and Including Fans: 2-inch wg.

5. Panels and Doors:

a. Panels:

1) Fabrication: Formed and reinforced with same materials and insulation thickness as casing.
2) Fasteners: Two or more camlock type for panel lift-out operation. Arrangement is to allow panels to be opened against airflow.
3) Gasket: Neoprene, applied around entire perimeters of panel frames.
4) Size: Large enough to allow unobstructed access for inspection and maintenance of air-handling unit's internal components. At least 18 inches wide by full height of unit casing up to a maximum height of 60 inches.

b. Doors:

1) Fabrication: Formed and reinforced with same materials and insulation thickness as casing.
2) Hinges: A minimum of two ball-bearing hinges or stainless steel piano hinge and two wedge-lever-type latches, operable from inside and outside. Arrange doors to be opened against airflow. Provide safety latch retainers on doors so that doors do not open uncontrollably.
3) Gasket: Neoprene, applied around entire perimeters of frame.
4) Size: Large enough to allow for unobstructed access for inspection and maintenance of air-handling unit's internal components. At least

18 inches wide by full height of unit casing up to a maximum height of 60 inches.

c. Locations and Applications:

1) Fan Section: Panels.
2) Coil Section: Panels.
3) Filter Section: Doors large enough to allow periodic removal and installation of filters.
4) Mixing Section: Panels.

6. Condensate Drain Pans:

a. Location: Each type of cooling coil.
b. Construction:

1) Single-wall, stainless steel sheet.

c. Drain Connection:

1) Located at lowest point of pan and sized to prevent overflow. Terminate with threaded nipple on one end of pan.
2) Minimum Connection Size: NPS 1.

d. Slope: Minimum 0.125 in./ft. slope, to comply with ASHRAE 62.1, in at least two planes to collect condensate from cooling coils (including coil piping connections, coil headers, and return bends) and from humidifiers, and to direct water toward drain connection.
e. Length: Extend drain pan downstream from leaving face for distance to comply with ASHRAE 62.1.
f. Width: Entire width of water producing device.
g. Depth: A minimum of 2 inches deep.

C. Fan, Drive, and Motor Section:

1. Fan and Drive Assemblies: Statically and dynamically balanced and designed for continuous operation at maximum-rated fan speed and motor horsepower.
2. Fans: Centrifugal, galvanized steel; mounted on solid-steel shaft.

a. Shafts: With field-adjustable alignment.

1) Turned, ground, and polished hot-rolled steel with keyway.

b. Shaft Bearings:

1) Heavy-duty, self-aligning, pillow-block type with an L-50 rated life of minimum 100,000 hours in accordance with ABMA 9.

c. Housings: Formed- and reinforced-steel panels to form curved scroll housings with shaped cutoff and spun-metal inlet bell.

1) Bracing: Steel angle or channel supports for mounting and supporting

fan scroll, wheel, motor, and accessories.

d. Housings, Plenum Fans: Steel frame and panel; fabricated without fan scroll and volute housing. Provide inlet screens for Type SWSI fans.
e. Forward-Curved, Centrifugal Fan Wheels: Inlet flange, backplate, and shallow blades with inlet and tip curved forward in direction of airflow and mechanically fastened to flange and backplate; steel hub swaged to backplate and fastened to shaft with setscrews.
f. Airfoil, Centrifugal Fan Wheels (Plenum Fan Wheels): Smooth-curved inlet flange, backplate, and hollow die-formed airfoil-shaped blades continuously welded at tip flange and backplate; steel hub riveted to backplate and fastened to shaft with setscrews.
g. Mounting: For internal vibration isolation. Factory-mount fans with manufacturer's standard restrained vibration isolation mounting devices having a minimum static deflection of 1 inch.
h. Shaft Lubrication Lines: Extended to a location outside the casing.
i. Flexible Connector: Factory fabricated with a fabric strip minimum **3-1/2 inches** wide, attached to two strips of minimum **2-3/4-inch-** wide by **0.028-inch-** thick, galvanized-steel sheet.

1) Flexible Connector Fabric: Glass fabric, double coated with neoprene. Fabrics, coatings, and adhesives are to comply with UL 181, Class 1.

3. Drive, Direct: Factory-mounted, direct drive.
4. Drive, Belt: Factory-mounted, V-belt drive, with adjustable alignment and belt tensioning, and with 1.5 service factor based on fan motor.

a. Pulleys: Cast iron or cast steel with split, tapered bushing, dynamically balanced at the factory.
b. Belts: Oil resistant, non-sparking and nonstatic; in matched sets for multiple-belt drives.
c. Belt Guards: Comply with requirements specified by OSHA and fabricate in accordance with SMACNA's "HVAC Duct Construction Standards"; 0.146-inch- thick, 3/4-inch diamond-mesh wire screen, welded to steel angle frame; prime coated.

5. Motors:

a. Comply with NEMA designation, temperature rating, service factor, and efficiency requirements for motors specified in Section 230500 "Common Work Results for HVAC."
b. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.
c. Enclosure Type: Open, dripproof.
d. Enclosure Materials: Cast iron.
e. Efficiency: Premium efficient as defined in NEMA MG 1.
f. Motor Pulleys: Adjustable pitch for use with 5 -hp motors and smaller; fixed pitch for use with motors larger than 5 hp. Select pulley size so pitch adjustment is at the middle of adjustment range at fan design conditions.

g. Controllers, Electrical Devices, and Wiring: Comply with requirements for electrical devices and connections specified in electrical Sections.

6. Comply with Section 262923 "Variable-Frequency Motor Controllers."

D. Coil Section:

1. General Requirements for Coil Section:

a. Comply with AHRI 410.
b. Fabricate coil section to allow removal and replacement of coil for maintenance and to allow in-place access for service and maintenance of coil(s).
c. Coils are not to act as structural component of unit.

2. Heating Coils:

a. Electrical Coils: Comply with UL 1995.

1) Casing Assembly: Flanged type with galvanized-steel frame.
2) Open Heating Elements: Resistance wire of 80 percent nickel and 20 percent chromium supported and insulated by floating ceramic bushings recessed into casing openings, fastened to supporting brackets, and mounted in galvanized-steel frame.
3) Overtemperature Protection: Disk-type, automatically resetting, thermal-cutout, safety device; serviceable through terminal box without removing heater from coil section.
4) Secondary Protection: Load-carrying, manually resetting or manually replaceable, thermal cutouts; factory wired in series with each heater stage.

3. Cooling Coils:

a. Refrigerant Coil:

1) Tubes: Copper.
2) Fins:

a) Material: Aluminum.

3) Fin and Tube Joints: Mechanical bond.
4) Headers: Seamless-copper headers with brazed connections.
5) Frames: Galvanized steel.
6) Coatings: None.
7) Ratings: Designed, tested, and rated in accordance with ASHRAE 33 and AHRI 410.

a) Working Pressure: Minimum **400 psig**.

E. Air Filtration Section:

1. Particulate air filtration is specified in Section 234100 "Particulate Air Filtration."
2. Panel Filters:

    a. Description: Pleated factory-fabricated, self-supported disposable air filters with holding frames.
    b. Filter Unit Class: UL 900.
    c. Media: Interlaced glass, synthetic, or cotton fibers coated with nonflammable adhesive and antimicrobial coating.
    d. Filter-Media Frame: High wet-strength beverage board with perforated metal retainer, or metal grid, on outlet side.

3. Adhesive, Sustainability Projects: As recommended by air-filter manufacturer and with a VOC content of 80 g/L or less.
4. Adhesive, LEED for Schools Projects: As recommended by air-filter manufacturer and that complies with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
5. Side-Access Filter Mounting Frames:

    a. Particulate Air Filter Frames: Match inner casing and outer casing material, and insulation thickness. Galvanized steel track.

        1) Sealing: Incorporate positive-sealing device to ensure seal between gasketed material on channels to seal top and bottom of filter cartridge frames to prevent bypass of unfiltered air.

F. Materials:

1. Steel:

    a. ASTM A36/A36M for carbon structural steel.
    b. ASTM A568/A568M for steel sheet.

2. Stainless Steel:

    a. Manufacturer's standard grade for casing.
    b. Manufacturer's standard type, ASTM A240/A240M for bare steel exposed to airstream or moisture.

3. Galvanized Steel: ASTM A653/A653M.
4. Aluminum: ASTM B209.

2.3 SOURCE QUALITY CONTROL

A. AHRI 430 Certification: Test, rate, and label air-handling units and their components in accordance with AHRI 430.

B. AHRI 260 or AMCA 311 Sound Performance Rating Certification: Test, rate, and label in accordance with AHRI 260 or AMCA 311.

C. Fan Aerodynamic Performance Rating: Factory test and rate fan performance for airflow, pressure, power, air density, rotation speed, and efficiency in accordance with AMCA 210.

D. Fan Energy Index (FEI): Test in accordance with AMCA 210 and rate in accordance with AMCA 99, AMCA 207, and AMCA 208.

E. Fan Operating Limits: Classify fans in accordance with AMCA 99, Section 14.

F. Refrigerant Coils: Factory tested to minimum **450-psig** internal pressure, and to minimum **300-psig** internal pressure while underwater, in accordance with AHRI 410 and ASHRAE 33.

PART 3 - EXECUTION

3.1 INSTALLATION OF INDOOR, BASIC AIR-HANDLING UNITS

A. Equipment Mounting:

1. Install air-handling units on cast-in-place concrete equipment bases. Coordinate sizes and locations of concrete bases with actual equipment provided. Comply with requirements for equipment bases and foundations specified in Section 033000 "Cast-in-Place Concrete."
2. Comply with requirements for vibration isolation and seismic-control devices specified in Section 230548 "Vibration and Seismic Controls for HVAC."
3. Comply with requirements for vibration isolation devices specified in Section 230548.13 "Vibration Controls for HVAC."

B. Suspended Units: Suspend and brace units from structural-steel support frame using threaded steel rods and spring hangers. Coordinate sizes and locations of structural-steel support members with actual equipment provided. Comply with requirements for vibration isolation devices specified inSection 230548.13 "Vibration Controls for HVAC."

C. Arrange installation of units to provide access space around air-handling units for service and maintenance.

D. Do not operate fan system until filters (temporary or permanent) are in place. Replace temporary filters used during construction and testing with new, clean filters.

E. Connect duct to air-handling units with flexible connections. Comply with requirements in Section 233300 "Air Duct Accessories."

3.2 FIELD QUALITY CONTROL

A. Testing Agency: Contractor will engage a qualified testing agency to perform tests and inspections.

B. Manufacturer's Field Service: Engage a factory-authorized service representative to

test and inspect components, assemblies, and equipment installations, including connections.

C. Perform the following tests and inspections with the assistance of a factory-authorized service representative:

1. Leak Test: After installation, fill water and steam coils with water, and test coils and connections for leaks.
2. Charge refrigerant coils with refrigerant and test for leaks.
3. Fan Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
4. Air-handling unit and components will be considered defective if unit or components do not pass tests and inspections.
5. Prepare test and inspection reports.

3.3 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain air-handling units.

END OF SECTION 23 73 13.13

SECTION 237433 - DEDICATED OUTDOOR-AIR UNITS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Dedicated outdoor-air units.

1.2 ACTION SUBMITTALS

A. Product Data:

1. For each type of product.

a. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
b. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
c. Include unit dimensions and weight.
d. Include cabinet material, metal thickness, finishes, insulation, and accessories.
e. Fans:

1) Certified fan-performance curves with system operating conditions indicated.
2) Certified fan-sound power ratings.
3) Fan construction and accessories.
4) Motor ratings, electrical characteristics, and motor accessories.

f. Include certified coil-performance ratings with system operating conditions indicated.
g. Include filters with performance characteristics.
h. Include heat exchangers with performance characteristics.
i. Include dampers, including housings, linkages, and operators.

B. Sustainable Design Submittals:

1. Product Data: For air filtration performance.

C. Shop Drawings: For each dedicated outdoor-air unit.

1. Include plans, elevations, sections, and mounting details.
2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
3. Include diagrams for power, signal, and control wiring.

D. Delegated Design Submittal: For dedicated outdoor-air-unit supports indicated to comply with performance and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1. Include design calculations for selecting vibration isolators, wind restraints, and for designing vibration isolation bases.
2. Wind- Restraint Details: Detail fabrication and attachment of wind and seismic restraints and snubbers. Show anchorage details and indicate quantity, diameter, and depth of penetration of anchors.
3. Detail mounting, securing, and flashing of roof curb to roof structure. Indicate coordinating requirements with roof membrane system.

1.3 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Floor/roof plans and other details, or BIM model, drawn to scale, showing the items described in this Section, and coordinated with all building trades.

B. Sample Warranty: For manufacturer's warranty.

C. Seismic Qualification Data: Certificates, for dedicated outdoor-air units, accessories, and components, from manufacturer.

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
4. Restraint of internal components.

D. Product Certificates: Submit certification that specified equipment will withstand wind forces identified in "Performance Requirements" Article and in Section 230548 "Vibration and Seismic Controls for HVAC."

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculations.
2. Dimensioned Outline Drawings of Equipment Unit: Identify center of wind force and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

E. Source quality-control reports.

F. Startup service reports.

G. Field quality-control reports.

1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For dedicated outdoor-air units to include in emergency, operation, and maintenance manuals.

1.5 WARRANTY

A. Warranty: Manufacturer agrees to replace components of dedicated outdoor-air units that fail in materials or workmanship within specified warranty period.

1. Warranty Period for Dedicated Outdoor-Air-Handling Units: Two years from date of Substantial Completion.
2. Warranty Period for Compressors: Five years from date of Substantial Completion.
3. Warranty Period for Heat Exchangers: Five years from date of Substantial Completion.
4. Warranty Period for Rotary Heat Exchangers: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by an "NRTL" (nationally recognized testing laboratory), and marked for intended location and application.

B. NFPA Compliance: Comply with NFPA 90A for design, fabrication, and installation of units and components.

C. ASHRAE 62.1 Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and Startup."

D. ASHRAE 15 and ASHRAE 34 Compliance: For refrigeration system safety.

E. ASHRAE/IES 90.1 Compliance: Applicable requirements in ASHRAE/IES 90.1, Section 6 - "Heating, Ventilating, and Air-Conditioning."

F. UL Compliance:

1. Electric Coils: Comply with requirements in UL 1995.

G. Wind-Restraint Performance:

1. See Section 230548.13 "Vibration Controls for HVAC" for requirements.

2.2 DEDICATED OUTDOOR-AIR UNITS

A. Manufacturers: Subject to compliance with requirements, provide products by the following:

1. AAON
2. Addison
3. Desert Aire

B. Source Limitations: Obtain dedicated outdoor-air units from single manufacturer.

C. Unit Casing:

1. General Fabrication Requirements for Casings: Formed and reinforced double-wall insulated panels, fabricated to allow removal for access to internal parts and components, with joints between sections sealed.
2. Double-Wall Configuration:

    a. Outside Casing Wall: Galvanized steel, stainless steel in cooling coil section, minimum 18 gauge thick with manufacturer's standard finish, with pitched roof panels and knockouts with grommet seals for electrical and piping connections and lifting lugs.
    b. Inside Casing Wall:

        1) Inside Casing, Burner Section: Galvanized steel.
        2) Inside Casing, All Other Sections: Galvanized steel.

    c. Casing Insulation:

        1) Materials: Polyurethane foam insulation.
        2) Casing Panel R-Value: MinimumR-13.
        3) Insulation Thickness: 2 inches.
        4) Thermal Break: Provide continuity of insulation with no through-casing metal in casing walls, floors, or roofs of air-handling unit.

3. Airstream Surfaces: Surfaces in contact with airstream are to comply with requirements in ASHRAE 62.1.
4. Static-Pressure Classifications:

    a. For Unit Sections Upstream of Fans: Minus 2 inches wg.
    b. For Unit Sections Downstream and Including Fans: 2 inches wg.

5. Panels and Doors:

    a. Panels:

        1) Fabrication: Formed and reinforced double-wall and insulated panels of same materials and thicknesses as casing.
        2) Fasteners: Two or more camlock-type fasteners for panel lift-out operation. Arrangement is to allow panels to be opened against airflow.

3) Gasket: Neoprene, applied around entire perimeters of panel frames.
4) Size: Large enough to allow unobstructed access for inspection and maintenance of unit's internal components.

b. Doors:

1) Fabrication: Formed and reinforced double-wall and insulated panels of same materials and thicknesses as casing.
2) Hinges: A minimum of two ball-bearing hinges or stainless steel piano hinge and two wedge-lever latches, operable from inside and outside. Arrange doors to be opened against airflow. Provide safety latch retainers on doors so that doors do not open uncontrollably.
3) Gasket: Neoprene, applied around entire perimeters of panel frames.
4) Size: Large enough to allow for unobstructed access for inspection and maintenance of air-handling unit's internal components.

c. Locations and Applications:

1) Fan Section: Doors.
2) Filter Section: Doors large enough to allow periodic removal and installation of filters.

6. Condensate Drain Pans:

a. Location: Each refrigerant coil.
b. Construction:

1) Single-wall, stainless steel sheet.

c. Size: Large enough to collect condensate from cooling coils, including coil piping connections, coil headers, and return bends.
d. Drain Connection:

1) Located on one end of pan, at lowest point of pan.
2) Terminated with threaded nipple.
3) Minimum Connection Size: NPS 1.

e. Slope: Minimum 0.125-inch/ft. slope, to comply with ASHRAE 62.1, in at least two planes to collect condensate from cooling coils (including coil piping connections, coil headers, and return bends) and from humidifiers and to direct water toward drain connection.
f. Length: Extend drain pan downstream from leaving face for distance to comply with ASHRAE 62.1.
g. Width: Entire width of water-producing device.
h. Depth: A minimum of 2 inches deep.
i. Pan-Top Surface Coating for Galvanized-Steel Drain Pans: Asphaltic waterproofing compound.
j. Provide units having stacked coils with intermediate drain pan to collect condensate from top coil.

D. Fans, Drives, And Motors:

1. Fan and Drive Assemblies: Statically and dynamically balanced and designed for continuous operation at maximum-rated fan speed and motor horsepower.
2. Supply-Air Fans and Relief-Air Fans: Centrifugal; galvanized or painted steel; mounted on solid-steel shaft.

    a. Shafts: With field-adjustable alignment.

        1) Turned, ground, and polished hot-rolled steel with keyway.

    b. Shaft Bearings:

        1) Heavy-duty, self-aligning, pillow-block type with an L-50 rated life of minimum 100,000 hours in accordance with ABMA 9.

    c. Housings: Formed- and reinforced-steel panels to form curved scroll housings with shaped cutoff and spun-metal inlet bell.

        1) Bracing: Steel angle or channel supports for mounting and supporting fan scroll, wheel, motor, and accessories.

    d. Housings, Plenum Fans: Steel frame and panel; fabricated without fan scroll and volute housing. Provide inlet screens for Type SWSI fans.
    e. Backward-Inclined, Centrifugal Fan Wheels: Construction with curved inlet flange, backplate, backward-inclined blades welded or riveted to flange and backplate; steel hub riveted to backplate and fastened to shaft with setscrews.
    f. Mounting: For internal vibration isolation. Factory mount fans with manufacturer's standard restrained vibration isolation mounting devices having a minimum static deflection of 1 inch.
    g. Shaft Lubrication Lines: Extended to a location outside the casing.
    h. Flexible Connector: Factory fabricated with a fabric strip minimum **3-1/2 inches** wide, attached to two strips of minimum **2-3/4-inch-** wide by **0.028-inch-** thick, galvanized-steel sheet.

        1) Flexible Connector Fabric: Glass fabric, double coated with neoprene. Fabrics, coatings, and adhesives are to comply with UL 181, Class 1.

3. Drive, Direct: Factory-mounted direct drive.
4. Drive, Belt: Factory-mounted V-belt drive, with adjustable alignment and belt tensioning, and with 1.5 service factor based on fan motor.

    a. Pulleys: Cast iron or cast steel with split, tapered bushing, dynamically balanced at the factory.
    b. Belts: Oil resistant, nonsparking and nonstatic; in matched sets for multiple-belt drives.
    c. Belt Guards: Comply with requirements specified by OSHA and fabricate in accordance with SMACNA's "HVAC Duct Construction Standards"; 0.146 inch thick, 3/4-inch diamond-mesh wire screen, welded to steel angle frame; prime coated.

5. Condenser-Coil Fan: propeller, mounted on shaft of permanently lubricatedelectronically commutated motors.
6. Motors:

    a. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Section 230500 "Common Work Results for HVAC."
    b. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.
    c. Enclosure Type: Open, dripproof.
    d. Enclosure Materials: Cast iron.
    e. Motor Bearings: ball, permanently lubricated, double-sealed.
    f. Efficiency: Premium efficient as defined in NEMA MG 1.
    g. Motor Pulleys: Adjustable pitch for use with 5 hp motors and smaller; fixed pitch for use with motors larger than 5 hp. Select pulley size so pitch adjustment is at the middle of adjustment range at fan design conditions.
    h. Controllers, Electrical Devices, and Wiring: Comply with requirements for electrical devices and connections specified in electrical Sections.

7. Variable-Frequency Motor Controller: Serving each fan individually in fan array.

    a. Manufactured Units: Pulse-width modulated; constant torque and variable torque forinverter-duty motors.
    b. Output Rating: Three phase; 10 to 60 Hz, with voltage proportional to frequency throughout voltage range; maximum voltage equals input voltage.
    c. Unit Operating Requirements:

        1) Internal Adjustability:

            a) Minimum Speed: 5 to 25 percent of maximum rpm.
            b) Maximum Speed: 80 to 100 percent of maximum rpm.
            c) Acceleration: 0.1 to 999.9 seconds.
            d) Deceleration: 0.1 to 999.9 seconds.
            e) Current Limit: 30 to minimum of 150 percent of maximum rating.

        2) Self-Protection and Reliability Features:

            a) Surge suppression.
            b) Loss of input signal protection.
            c) Under- and overvoltage trips.
            d) Variable-frequency motor controller and motor-overload/overtemperature protection.
            e) Critical frequency rejection.
            f) Loss-of-phase protection.
            g) Reverse-phase protection.
            h) Motor-overtemperature fault.

        3) Bidirectional autospeed search.

4) Torque boost.
5) Motor temperature compensation at slow speeds.

a) Panel-mounted operator station.
b) Historical logging information and displays.
c) Digital indicating devices.

6) Control Signal Interface: Electric.
7) Proportional Integral Directive (PID) control interface.

d. Line Conditioning:

1) Input line conditioning.
2) Output filtering.
3) EMI/RFI filtering.

e. Bypass Systems:

1) Bypass Mode: Field-selectable automatic or manual.
2) Bypass Controller, Two-Contactor Style: With bypass and output isolating contactors and isolating switch.
3) Bypass Controller, Three-Contactor Style: With bypass and input and output isolating contactors and isolating switch.
4) Bypass Contactor Configuration: Full-voltage (across the line) type.

E. Coils:

1. General Requirements for Coils:

a. Comply with AHRI 410.
b. Fabricate coils section to allow removal and replacement of coil for maintenance and to allow in-place access for service and maintenance of coil(s).
c. Coils are not to act as structural component of unit.

2. Supply-Air Refrigerant Coils:

a. Tubes: Copper.
b. Fins:

1) Material: Aluminum.
2) Fin Spacing: Maximum 12 fins per **inch**.

c. Fin and Tube Joints: Mechanical bond.
d. Headers: Seamless-copper headers with brazed connections.
e. Frames: Galvanized steel.
f. Coatings: None.
g. Ratings: Designed, tested, and rated in accordance with ASHRAE 33 and AHRI 410.

1) Working Pressure: Minimum **300 psig**.

3. Hot-Gas Reheat Refrigerant Coils:

    a. Tubes: Copper.
    b. Fins:

        1) Material: Aluminum.
        2) Fin Spacing: Maximum 12 fins per **inch**.

    c. Fin and Tube Joints: Mechanical bond.
    d. Headers: Seamless-copper headers with brazed connections.
    e. Frames: Galvanized steel.
    f. Coatings: None.
    g. Ratings: Designed, tested, and rated in accordance with ASHRAE 33 and AHRI 410.

        1) Working Pressure: Minimum **300 psig**.

    h. Coating: None.
    i. Suction-discharge bypass valve.

4. Electric-Resistance Heating Coils: Comply with UL 1995.

    a. Casing Assembly: Flanged type with galvanized-steel frame.
    b. Open Heating Elements: Resistance wire of 80 percent nickel and 20 percent chromium supported and insulated by floating ceramic bushings recessed into casing openings, fastened to supporting brackets, and mounted in galvanized-steel frame.
    c. Overtemperature Protection: Disk-type, automatically resetting, thermal-cutout, safety device; serviceable through terminal box without removing heater from coil section.
    d. Secondary Protection: Load-carrying, manually resetting or manually replaceable, thermal cutouts; factory wired in series with each heater stage.
    e. Control Panel: Unit mounted with disconnecting means and overcurrent protection.

        1) Magnetic contactor.
        2) Solid-state, stepless pulse controller.
        3) Toggle switches, one per step.
        4) SCR controller.
        5) Time-delay relay.
        6) Pilot lights, one per step.
        7) Airflow proving switch.

F. Refrigeration Circuit Components:

1. Compressors: Hermetic, variable-speed scroll compressors, mounted on integral vibration isolators; with internal overcurrent and high-temperature protection, internal pressure relief, and crankcase heater.
2. Refrigerant: R-454B.
3. Refrigeration Specialties:

a. Expansion valve with replaceable thermostatic element.
b. Refrigerant filter/dryer.
c. Manual-reset high-pressure safety switch.
d. Automatic-reset low-pressure safety switch.
e. Minimum off-time relay.
f. Automatic-reset compressor motor thermal overload.
g. Thermostat for coil freeze-up protection during low-ambient-temperature operation or loss of air.
h. Brass service valves installed in discharge and liquid lines.
i. Low-ambient kit high-pressure sensor.
j. Single compressor with evaporator and condenser coil within the refrigerant section to provide initial pre-cooling and to reheat for humidity control.
k. Modulating hot-gas reheat solenoid valve with a replaceable magnetic coil.
l. Heat-pipe heat exchanger, wrapped around the evaporator coil to pre-cool the air entering the evaporator coil and reheat the air leaving the evaporator coil to control humidity.
m. Hot-gas bypass refrigerant control for capacity control with continuous dehumidification for single-speed compressor.

G. Air Filtration:

1. Particulate air filtration is specified in Section 234100 "Particulate Air Filtration."
2. Panel Filters:

a. Description: Flat, Pleated factory-fabricated, self-supported disposable air filters with holding frames.
b. Filter Unit Class: UL 900.
c. Media: Interlaced glass, synthetic, or cotton fibers coated with nonflammable adhesive and antimicrobial coating.
d. Filter-Media Frame: High wet-strength beverage board with perforated metal retainer, or metal grid, on outlet side.

H. Adhesive: As recommended by air-filter manufacturer and with a VOC content of 80 g/L or less.

1. Mounting Frames:

a. Panel filters arranged for flat or angular orientation, with access doors on both sides of unit. Filters are to be removable from one side or from access plenum.
b. Cartridge filters arranged for flat orientation, removable from access plenum.

I. Electrical Power Connections:

1. Single-Point Power Connection: Factory-installed and -wired switches, motor controllers, transformers, and other necessary electrical devices are to provide a single-point field power connection to unit.
2. Enclosure: NEMA 250, Type 3R, mounted in unit with hinged access door in unit cabinet having a lock and key or padlock and key.

3. Wiring: Numbered and color-coded to match wiring diagram.
4. Wiring Location: Install factory wiring outside an enclosure in a raceway.
5. Power Interface: Field power interface to be wire lugs.
6. Factory Wiring: Branch power circuit to each motor and to controls with one of the following disconnecting means:

    a. NEMA KS 1, heavy-duty, fusible switch with rejection-type fuse clips rated for fuses. Select and size fuses to provide Type 2 protection in accordance with IEC 60947-4-1.
    b. NEMA KS 1, heavy-duty, nonfusible switch.
    c. UL 489, motor-circuit protector (circuit breaker) with field-adjustable, short-circuit trip coordinated with motor locked-rotor amperes.

7. Factory-Mounted, Overcurrent-Protection Service: For each motor.
8. Transformer: Factory mounted with primary and secondary fuses and sized with enough capacity to operate electrical load plus spare capacity.
9. Control Relays: Auxiliary and adjustable time-delay relays.

J. Controls:

1. Control Wiring: Factory wire connection for controls' power supply.
2. Control Devices: Sensors, transmitters, relays, switches, detectors, operators, actuators, and valves are to be manufacturer's standard items to accomplish indicated control functions.
3. Status Panel: Unit mounted.

    a. Cooling/Off/Heating Controls: Control operational mode.
    b. Damper Position: Indicate position of outdoor-air dampers in terms of percentage of outdoor air.
    c. Status Lights:

        1) Filter dirty.
        2) Fan operating.
        3) Cooling operating.
        4) Heating operating.
        5) General alarm.

4. Refrigeration System Controls:

    a. Unit-mounted enthalpy controller is to lock out refrigerant system when outdoor-air enthalpy is less than 28 Btu/lb of dry air or outdoor-air temperature is less than **60 deg F**.
    b. Outdoor-air sensor de-energizes dehumidifier operation when outdoor-air temperature is less than **60 deg F**.
    c. Relative-humidity sensor energizes dehumidifier operation when relative humidity is more than 50 percent.

5. Electric-Resistance Heat Controls:

    a. Factory-mounted sensor in unit discharge with sensor adjustment located in control panel to control electric coil to maintain temperature.

b. Wall-mounted, space-temperature sensor withunit-mounted temperature adjustment to control electric coil to maintain temperature.
c. Capacity Controls: Modulating SCR.

2.3 MATERIALS

A. Steel:

1. ASTM A36/A36M for carbon structural steel.
2. ASTM A568/A568M for steel sheet.

B. Stainless Steel:

1. Manufacturer's standard grade for casing.
2. Manufacturer's standard type, ASTM A240/A240M for bare steel exposed to airstream or moisture.

C. Galvanized Steel: ASTM A653/A653M.

D. Aluminum: **ASTM B209**.

E. Comply with Section 230546 "Coatings for HVAC" for corrosion-resistant coating.

2.4 SOURCE QUALITY CONTROL

A. AHRI 920: Manufacturer to certify that performance ratings are in accordance with AHRI 920 if AHRI 920 certification program is not in place. Provide AHRI 920 certification if AHRI 920 certification program is in place.

B. AHRI 260 or AMCA 311 Sound Performance Rating Certification: Test, rate, and label unit fan sound ratings in accordance with AHRI 260 or AMCA 311.

C. Fan Aerodynamic Performance Rating: Test and rate fan performance for airflow, pressure, power, air density, rotation speed, and efficiency.

D. Fan Energy Index (FEI): Test in accordance with AMCA 210 and rate in accordance with AMCA 99, AMCA 207, and AMCA 208.

E. Fan Operating Limits: Classify fans in accordance with AMCA 99, Section 14.

F. Refrigerant Coils: Factory tested to minimum 450 psig internal pressure and to minimum 300 psig internal pressure while under water, in accordance with AHRI 410 and ASHRAE 33.

PART 3 - EXECUTION

3.1 INSTALLATION OF DEDICATED OUTDOOR-AIR UNITS

A. Unit Support: Install unit level on insulated non-combustible plenum as called out on the drawings. Comply with requirements for vibration isolation devices specified in Section 230548.13 "Vibration Controls for HVAC."

B. Do not operate fan system until filters (temporary or permanent) are in place. Replace temporary filters used during construction and testing with new, clean filters.

C. Install filter-gauge, static-pressure taps upstream and downstream of filters. Mount filter gauges on outside of filter housing or filter plenum in accessible position. Provide filter gauges on filter banks, installed with separate static-pressure taps upstream and downstream of filters.

D. Connect duct to air-handling units with flexible connections. Comply with requirements in Section 233300 "Air Duct Accessories."

E. Install wall- and duct-mounted sensors furnished by manufacturer for field installation. Install control wiring and make final connections to control devices and unit control panel.

F. Comply with requirements for gas-fired furnace installation in NFPA 54.

G. Install separate devices furnished by manufacturer and not factory installed.

H. Install new filters at completion of equipment installation and before testing, adjusting, and balancing.

3.2 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

C. Perform the following tests and inspections with the assistance of a factory-authorized service representative:

1. Leak Test: After installation, fill water and steam coils with water, and test coils and connections for leaks.
2. Charge refrigerant coils with refrigerant and test for leaks.
3. Fan Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.

3.3 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain units.

END OF SECTION 23 74 33

SECTION 23 81 26 - SPLIT-SYSTEM AIR-CONDITIONERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Split-system air-conditioners.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product:

1. Include rated capacities, operating characteristics, and furnished specialties and accessories. Include performance data in terms of capacities, outlet velocities, static pressures, sound power characteristics, motor requirements, and electrical characteristics.

B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.

1. Include detail of equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
2. Wiring Diagrams: For power, signal, and control wiring.

C. Samples for Initial Selection: For units with factory-applied color finishes.

D. Sustainable Design Submittals:

1. Product Data: For energy performance.

1.3 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

B. Warranty: Sample of special warranty.

1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For split-system air-conditioning units to include in emergency, operation, and maintenance manuals.

1.5 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Filters: One set(s) for each air-handling unit.
2. Gaskets: One set(s) for each access door.
3. Fan Belts: One set(s) for each air-handling unit fan.

1.6 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. ASHRAE Compliance:

1. Fabricate and label refrigeration system to comply with ASHRAE 15.

1.7 COORDINATION

A. Coordinate sizes and locations of concrete bases with actual equipment provided. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork are specified in Section 033000 "Cast-in-Place Concrete."

B. Coordinate sizes and locations of roof curbs, equipment supports, and roof penetrations with actual equipment provided.

1.8 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of split-system air-conditioning units that fail in materials or workmanship within specified warranty period.

1. Warranty Period:

a. For Compressor: Five year(s) from date of Substantial Completion.
b. For Parts: Five year(s) from date of Substantial Completion.
c. For Labor: One year(s) from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 SPLIT-SYSTEM AIR-CONDITIONERS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Carrier Global Corporation
2. Trane
3. YORK; brand of Johnson Controls International plc, Building Solutions North America

B. Indoor Units (5 tons (18 kW) or Less):

1. Concealed Evaporator-Fan Components:

a. Chassis: Galvanized steel with flanged edges, removable panels for servicing, and insulation on back of panel.
b. Insulation: Faced, glass-fiber duct liner.
c. Refrigerant Coil: Copper tube, with mechanically bonded aluminum fins and thermal-expansion valve. Comply with ARI 206/110.
d. Water Coil: Copper tube, with mechanically bonded aluminum fins spaced no closer than **0.1 inch**; leak tested to **300 psig** underwater; with a two-position control valve.
e. Electric Coil: Helical, nickel-chrome, resistance-wire heating elements; with refractory ceramic support bushings, automatic-reset thermal cutout, built-in magnetic contactors, manual-reset thermal cutout, airflow-proving device, and one-time fuses in terminal box for overcurrent protection.
f. Fan: Forward-curved, double-width wheel of galvanized steel; directly connected to motor.
g. Fan Motors:

1) Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements specified in Section 230500 "Common Work Results for HVAC."
2) Multitapped, multispeed with internal thermal protection and permanent lubrication.
3) Wiring Terminations: Connect motor to chassis wiring with plug connection.

h. Filters: Permanent, cleanable.
i. Condensate Drain Pans:

1) Fabricated with 2 percent slope in at least two planes to collect condensate from cooling coils (including coil piping connections, coil headers, and return bends) and humidifiers, and to direct water toward drain connection.

a) Depth: A minimum of 2 inches deep.

2) Single-wall, galvanized- steel sheet.
3) Double-wall, stainless steel sheet with space between walls filled with foam insulation and moisture-tight seal.
4) Drain Connection: Located at lowest point of pan and sized to prevent overflow. Terminate with threaded nipple on one end of pan.

a) Minimum Connection Size: NPS 1.

5) Pan-Top Surface Coating: Asphaltic waterproofing compound.
6) Units with stacked coils are to have an intermediate drain pan to collect condensate from top coil.

2. Floor-Mounted, Evaporator-Fan Components:

a. Cabinet: Enameled steel with removable panels on front and ends in color selected by Architect.

1) Insulation: Faced, glass-fiber duct liner.
2) Drain Pans: Galvanized steel, with connection for drain; insulated.

b. Refrigerant Coil: Copper tube, with mechanically bonded aluminum fins and thermal-expansion valve. Comply with ARI 206/110.
c. Water Coil: Copper tube, with mechanically bonded aluminum fins spaced no closer than **0.1 inch**; leak tested to **300 psig** underwater; with a two-position control valve.
d. Electric Coil: Helical, nickel-chrome, resistance-wire heating elements; with refractory ceramic support bushings, automatic-reset thermal cutout, built-in magnetic contactors, manual-reset thermal cutout, airflow-proving device, and one-time fuses in terminal box for overcurrent protection.
e. Fan: Direct drive, centrifugal .
f. Fan Motors:

1) Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements specified in Section 230500 "Common Work Results for HVAC."
2) Multitapped, multispeed with internal thermal protection and permanent lubrication.

g. Air-Filtration Section:

a) Comply with NFPA 90A.
b) Minimum MERV in accordance with ASHRAE 52.2.
c) Filter-Holding Frames: Arranged for flat or angular orientation, with access doors on both sides of unit. Filters are to be removable from one side or lifted out from access plenum.

2) Disposable Panel Filters:

a) Factory-fabricated, viscous-coated, flat-panel type.
b) Thickness: 1 inch.
c) MERV in accordance with ASHRAE 52.2: 8.
d) Frame: Galvanized steel, with metal grid on outlet side, steel rod grid on inlet side, and hinged; with pull and retaining handles.

3) Extended-Surface, Disposable Panel Filters:

a) Factory-fabricated, dry, extended-surface type.
b) Thickness: 1 inch.

c) MERV in accordance with ASHRAE 52.2: 8.
d) Media-Grid Frame: Galvanized steel.
e) Mounting Frames: Welded, galvanized steel, with gaskets and fasteners; suitable for bolting together into built-up filter banks.

3. Wall-Mounted, Evaporator-Fan Components:

a. Cabinet: Enameled steel with removable panels on front and ends in color selected by Architect, and discharge drain pans with drain connection.
b. Refrigerant Coil: Copper tube, with mechanically bonded aluminum fins and thermal-expansion valve. Comply with ARI 206/110.
c. Electric Coil: Helical, nickel-chrome, resistance-wire heating elements; with refractory ceramic support bushings, automatic-reset thermal cutout, built-in magnetic contactors, manual-reset thermal cutout, airflow-proving device, and one-time fuses in terminal box for overcurrent protection.
d. Fan: Direct drive, centrifugal.
e. Fan Motors:

1) Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements specified in Section 230500 "Common Work Results for HVAC."
2) Multitapped, multispeed with internal thermal protection and permanent lubrication.
3) Enclosure Type: Totally enclosed, fan cooled.
4) NEMA Premium (TM) efficient motors as defined in NEMA MG 1.
5) Controllers, Electrical Devices, and Wiring: Comply with requirements for electrical devices and connections specified in electrical Sections.
6) Mount unit-mounted disconnect switches on exterior of unit.

f. Condensate Drain Pans:

1) Fabricated with 2 percent slope in at least two planes to collect condensate from cooling coils (including coil piping connections, coil headers, and return bends) and humidifiers, and to direct water toward drain connection.

a) Depth: A minimum of 1 inch deep.

2) Single-wall, galvanized- steel sheet.
3) Double-wall, stainless steel sheet with space between walls filled with foam insulation and moisture-tight seal.
4) Drain Connection: Located at lowest point of pan and sized to prevent overflow. Terminate with threaded nipple on one end of pan.
5) Minimum Connection Size: NPS 1.
6) Pan-Top Surface Coating: Asphaltic waterproofing compound.

g. Air-Filtration Section:

a) Comply with NFPA 90A.
b) Minimum MERV in accordance with ASHRAE 52.2.
c) Filter-Holding Frames: Arranged for flat or angular orientation,

with access doors on both sides of unit. Filters are to be removable from one side or lifted out from access plenum.

2) Disposable Panel Filters:

a) Factory-fabricated, viscous-coated, flat-panel type.
b) Thickness: 1 inch.
c) MERV in accordance with ASHRAE 52.2: 8.
d) Frame: Galvanized steel, with metal grid on outlet side, steel rod grid on inlet side, and hinged; with pull and retaining handles.

3) Extended-Surface, Disposable Panel Filters:

a) Factory-fabricated, dry, extended-surface type.
b) Thickness: 1 inch.
c) MERV in accordance with ASHRAE 52.2: 8.
d) Media-Grid Frame: Galvanized steel.
e) Mounting Frames: Welded, galvanized steel, with gaskets and fasteners; suitable for bolting together into built-up filter banks.

C. Indoor Units (6 tons (21 kW) or More:

1. Concealed Evaporator-Fan Components:

a. Chassis: Galvanized steel with flanged edges, removable panels for servicing, and insulation on back of panel.
b. Insulation: Faced, glass-fiber duct liner.
c. Refrigerant Coil: Copper tube, with mechanically bonded aluminum fins and thermal-expansion valve. Comply with ARI 206/110.
d. Water Coil: Copper tube, with mechanically bonded aluminum fins spaced no closer than **0.1 inch**; leak tested to **300 psig** underwater; with a two-position control valve.
e. Electric Coil: Helical, nickel-chrome, resistance-wire heating elements; with refractory ceramic support bushings, automatic-reset thermal cutout, built-in magnetic contactors, manual-reset thermal cutout, airflow-proving device, and one-time fuses in terminal box for overcurrent protection.
f. Fan: Forward-curved, double-width wheel of galvanized steel; directly connected to motor.
g. Fan Motors:

1) Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements specified in Section 230500 "Common Work Results for HVAC."
2) Multitapped, multispeed with internal thermal protection and permanent lubrication.
3) Three-phase, permanently lubricated, ball-bearing motors with built-in thermal-overload protection.
4) Wiring Terminations: Connect motor to chassis wiring with plug connection.

h. Filters: 1 inch thick, in fiberboard frames.
i. Condensate Drain Pans:

1) Fabricated with 2 percent slope in at least two planes to collect condensate from cooling coils (including coil piping connections, coil headers, and return bends) and humidifiers, and to direct water toward drain connection.

a) Depth: A minimum of 2 inches deep.

2) Single-wall, stainless steel sheet.
3) Double-wall, stainless steel sheet with space between walls filled with foam insulation and moisture-tight seal.
4) Drain Connection: Located at lowest point of pan and sized to prevent overflow. Terminate with threaded nipple on one end of pan.

a) Minimum Connection Size: NPS 1.

5) Pan-Top Surface Coating: Asphaltic waterproofing compound.
6) Units with stacked coils are to have an intermediate drain pan to collect condensate from top coil.

2. Floor-Mounted, Evaporator-Fan Components:

a. Cabinet: Enameled steel with removable panels on front and ends in color selected by Architect.

1) Insulation: Faced, glass-fiber duct liner.

b. Condensate Drain Pans:

1) Fabricated with 2 percent slope in at least two planes to collect condensate from cooling coils (including coil piping connections, coil headers, and return bends) and humidifiers, and to direct water toward drain connection.

a) Depth: A minimum of 2 inches deep.

2) Single-wall, stainless steel sheet.
3) Double-wall, stainless steel sheet with space between walls filled with foam insulation and moisture-tight seal.
4) Drain Connection: Located at lowest point of pan and sized to prevent overflow. Terminate with threaded nipple on one end of pan.

a) Minimum Connection Size: NPS 1.

5) Pan-Top Surface Coating: Asphaltic waterproofing compound.
6) Units with stacked coils are to have an intermediate drain pan to collect condensate from top coil.

c. Refrigerant Coil: Copper tube, with mechanically bonded aluminum fins

and thermal-expansion valve. Comply with ARI 206/110.

d. Water Coil: Copper tube, with mechanically bonded aluminum fins spaced no closer than **0.1 inch**; leak tested to **300 psig** underwater; with a two-position control valve.

e. Electric Coil: Helical, nickel-chrome, resistance-wire heating elements; with refractory ceramic support bushings, automatic-reset thermal cutout, built-in magnetic contactors, manual-reset thermal cutout, airflow-proving device, and one-time fuses in terminal box for overcurrent protection.

f. Fan Motors:

1) Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements specified in Section 230500 "Common Work Results for HVAC."
2) Multitapped, multispeed with internal thermal protection and permanent lubrication.
3) Enclosure Type: Totally enclosed, fan cooled.
4) NEMA Premium (TM) efficient motors as defined in NEMA MG 1.
5) Controllers, Electrical Devices, and Wiring: Comply with requirements for electrical devices and connections specified in electrical Sections.
6) Mount unit-mounted disconnect switches on exterior of unit.

g. Air-Filtration Section:

a) Comply with NFPA 90A.
b) Minimum MERV in accordance with ASHRAE 52.2.
c) Filter-Holding Frames: Arranged for flat or angular orientation, with access doors on both sides of unit. Filters are to be removable from one side or lifted out from access plenum.

2) Disposable Panel Filters:

a) Factory-fabricated, viscous-coated, flat-panel type.
b) Thickness: 2 inches.
c) MERV in accordance with ASHRAE 52.2: 8.
d) Frame: Galvanized steel, with metal grid on outlet side, steel rod grid on inlet side, and hinged; with pull and retaining handles.

3) Extended-Surface, Disposable Panel Filters:

a) Factory-fabricated, dry, extended-surface type.
b) Thickness: 2 inches.
c) MERV in accordance with ASHRAE 52.2: 8.
d) Media-Grid Frame: Galvanized steel.
e) Mounting Frames: Welded, galvanized steel, with gaskets and fasteners; suitable for bolting together into built-up filter banks.

3. Variable-Frequency Controllers:

a. Description: NEMA ICS 2, IGBT, PWM, VFC; listed and labeled as a complete unit and arranged to provide variable speed of an NEMA MG 1,

Design B, three-phase induction motor by adjusting output voltage and frequency.

b. Output Rating: Three-phase; 6 to 60 Hz, with voltage proportional to frequency throughout voltage range.

c. Unit Operating Requirements:

1) Input ac voltage tolerance of 208 V, plus or minus 5 percent.
2) Input-frequency tolerance of 06/11 Hz, plus or minus 6 percent.
3) Minimum Efficiency: 96 percent at 60 Hz, full load.
4) Minimum Displacement Primary-Side Power Factor: 96 percent.
5) Overload Capability: 1.1 times the base load current for 60 seconds; 2.0 times the base load current for 3 seconds.
6) Starting Torque: 100 percent of rated torque or as indicated.
7) Speed Regulation: Plus or minus 1 percent.

d. Isolated control interface to allow controller to follow control signal over an 11:1 speed range.

e. Internal Adjustability Capabilities:

1) Minimum Speed: 5 to 25 percent of maximum rpm.
2) Maximum Speed: 80 to 100 percent of maximum rpm.
3) Acceleration: 2 seconds to a minimum of 22 seconds.
4) Deceleration: 2 seconds to a minimum of 22 seconds.
5) Current Limit: 50 percent to a minimum of 110 percent of maximum rating.

f. Self-Protection and Reliability Features:

1) Input transient protection by means of surge protection devices (SPDs).
2) Undervoltage and overvoltage trips; inverter overtemperature, overload, and overcurrent trips.
3) Adjustable motor overload relays capable of NEMA ICS 2, Class 10 performance.
4) Notch filter to prevent operation of the controller-motor-load combination at a natural frequency of the combination.
5) Instantaneous line-to-line and line-to-ground overcurrent trips.
6) Loss-of-phase protection.
7) Reverse-phase protection.
8) Short-circuit protection.
9) Motor overtemperature fault.

g. Automatic Reset/Restart: Attempts three restarts after controller fault or on return of power after an interruption and before shutting down for manual reset or fault correction. Bidirectional autospeed search is to be capable of starting into rotating loads, spinning in either direction, and returning motor to set speed in proper direction, without damage to controller, motor, or load.

h. Power-Interruption Protection: Prevents motor from re-energizing after a power interruption until motor has stopped.

i. Torque Boost: Automatically varies starting and continuous torque to at

least 1.5 times the minimum torque to ensure high-starting torque and increased torque at slow speeds.

j. Motor Temperature Compensation at Slow Speeds: Adjustable current fall-back, based on output frequency for temperature protection of self-cooled, fan-ventilated motors at slow speeds.

k. Door-mounted, digital status lights indicate the following conditions:

1) Power on.
2) Run.
3) Overvoltage.
4) Line fault.
5) Overcurrent.
6) External fault.

l. Panel-Mounted Operator Station: Start-stop and auto-manual selector switches with manual-speed-control potentiometer and elapsed-time meter.

m. Meters or digital readout devices and selector switch, mounted flush in controller door and connected, are to indicate the following controller parameters:

1) Output frequency (hertz).
2) Motor speed (rpm).
3) Motor status (running, stop, fault).
4) Motor current (amperes).
5) Motor torque (percent).
6) Fault or alarming status (code).
7) Proportional-integral-derivative feedback signal (percent).
8) DC-link voltage (volts dc).
9) Set-point frequency (hertz).
10) Motor output voltage (volts).

n. Control Signal Interface:

1) Electric Input Signal Interface: A minimum of two analog inputs (0 to 10 V or 0/4-20 mA) and six programmable digital inputs.
2) Remote signal inputs capable of accepting any of the following speed-setting input signals from the control system:

a) 0 to 10 V dc.
b) 0-20 or 4-20 mA.
c) Potentiometer using up/down digital inputs.
d) Fixed frequencies using digital inputs.
e) RS485.
f) Keypad display for local hand operation.

3) Output signal interface with a minimum of one analog output signal (0/4-20 mA), which can be programmed to any of the following:

a) Output frequency (hertz).
b) Output current (load).
c) DC-link voltage (volts dc).

d) Motor torque (percent).
e) Motor speed (rpm).
f) Set-point frequency (hertz).

4) Remote indication interface with a minimum of two dry circuit relay outputs (120 V ac, 1 A) for remote indication of the following:

a) Motor running.
b) Set-point speed reached.
c) Fault and warning indication (overtemperature or overcurrent).
d) High- or low-speed limits reached.

o. Communications: RS485 interface allows VFC to be used with an external system within a multidrop LAN configuration. Interface allows all parameter settings of VFC to be programmed via BMS control. Provide capability for VFC to retain these settings within the nonvolatile memory.
p. Integral Disconnecting Means: NEMA AB 1, instantaneous-trip circuit breaker with lockable handle.
q. Accessories:

1) Devices are to be factory installed in controller enclosure unless otherwise indicated.
2) Push-Button Stations, Pilot Lights, and Selector Switches: NEMA ICS 2, heavy-duty type.
3) Standard Displays:

a) Output frequency (hertz).
b) Set-point frequency (hertz).
c) Motor current (amperes).
d) DC-link voltage (volts dc).
e) Motor torque (percent).
f) Motor speed (rpm).
g) Motor output voltage (volts).

D. Outdoor Units (5 tons (18 kW) or Less:

1. Air-Cooled, Compressor-Condenser Components:

a. Casing: Steel, finished with baked enamel in color selected by Architect, with removable panels for access to controls, weep holes for water drainage, and mounting holes in base. Provide brass service valves, fittings, and gage ports on exterior of casing.
b. Compressor: Hermetically sealed with crankcase heater and mounted on vibration isolation device. Compressor motor is to have thermal- and current-sensitive overload devices, start capacitor, relay, and contactor.

1) Compressor Type: Scroll.
2) Two-speed compressor motor with manual-reset high-pressure switch and automatic-reset low-pressure switch.
3) Refrigerant Coil: Copper tube, with mechanically bonded aluminum fins and liquid subcooler. Comply with ARI 206/110.

c. Heat-Pump Components: Reversing valve and low-temperature-air cutoff thermostat.
d. Fan: Aluminum-propeller type, directly connected to motor.
e. Motor: Permanently lubricated, with integral thermal-overload protection.
f. Low Ambient Kit: Permits operation down to **45 deg F**.
g. Mounting Base: Polyethylene.

E. Outdoor Units (6 tons (21 kW) or More:

1. Air-Cooled, Compressor-Condenser Components:

a. Casing: Steel, finished with baked enamel in color selected by Architect, with removable panels for access to controls, weep holes for water drainage, and mounting holes in base. Provide brass service valves, fittings, and gage ports on exterior of casing.
b. Compressor: Hermetically sealed with crankcase heater and mounted on vibration isolation device. Compressor motor is to have thermal- and current-sensitive overload devices, start capacitor, relay, and contactor.

1) Compressor Type: Scroll.
2) Two-speed compressor motor with manual-reset high-pressure switch and automatic-reset low-pressure switch.
3) Refrigerant Coil: Copper tube, with mechanically bonded aluminum fins and liquid subcooler. Comply with ARI 206/110.

c. Heat-Pump Components: Reversing valve and low-temperature-air cutoff thermostat.
d. Fan: Aluminum-propeller type, directly connected to motor.
e. Motor: Permanently lubricated, with integral thermal-overload protection.
f. Low Ambient Kit: Permits operation down to **45 deg F**.
g. Mounting Base: Polyethylene.

2. Water-Cooled, Compressor-Condenser Components:

a. Casing: Steel, finished with baked enamel in color selected by Architect, with removable panels for access to controls and mounting holes in base. Provide brass service valves, fittings, and gage ports on exterior of casing.
b. Compressor: Hermetically sealed with crankcase heater and mounted on vibration isolation device. Compressor motor is to have thermal- and current-sensitive overload devices, start capacitor, relay, and contactor.

1) Compressor Type: Scroll.
2) Two-speed compressor motor with manual-reset high-pressure switch and automatic-reset low-pressure switch.

c. Heat-Pump Components: Reversing valve.
d. Heat Exchanger: Copper tubes in copper tube or in steel shell, with water-temperature-actuated, water-regulating valve.

F. Accessories:

1. Control equipment and sequence of operation are specified in Section 230923 "Direct Digital Control (DDC) System for HVAC" and Section 230993.11 "Sequence of Operations for HVAC DDC."
2. Thermostat:

    a. Low voltage with subbase to control compressor and evaporator fan.
    b. Wireless infrared functioning to remotely control compressor and evaporator fan, with the following features:

        1) Compressor time delay.
        2) 24-hour time control of system stop and start.
        3) Liquid-crystal display indicating temperature, set-point temperature, time setting, operating mode, and fan speed.
        4) Fan-speed selection including auto setting.

3. Automatic-reset timer to prevent rapid cycling of compressor.
4. Refrigerant Line Kits: Soft-annealed copper suction and liquid lines factory cleaned, dried, pressurized, and sealed; factory-insulated suction line with flared fittings at both ends.
5. Drain Hose: For condensate.

    a. Monitor constant and variable motor loads.
    b. Monitor variable-frequency-drive operation.
    c. Monitor economizer cycle.
    d. Monitor cooling load.
    e. Monitor air distribution static pressure and ventilation air volumes.

G. Capacities and Characteristics: see drawings.

PART 3 - EXECUTION

3.1 INSTALLATION OF SPLIT-SYSTEM AIR-CONDITIONERS

A. Install units level and plumb.

B. Install evaporator-fan components using manufacturer's standard mounting devices securely fastened to building structure.

C. Install roof-mounted, compressor-condenser components on equipment supports specified in Section 077200 "Roof Accessories." Anchor units to supports with removable, cadmium-plated fasteners.

D. Equipment Mounting:

1. Install ground-mounted, compressor-condenser components on cast-in-place concrete equipment base(s). Comply with requirements for equipment bases and foundations specified in Section 033000 "Cast-in-Place Concrete."
2. Install ground-mounted, compressor-condenser components on polyethylene mounting base.

3. Comply with requirements for vibration isolation and seismic control devices specified in Section 230548 "Vibration and Seismic Controls for HVAC."
4. Comply with requirements for vibration isolation devices specified in Section 230548.13 "Vibration Controls for HVAC."

E. Install and connect precharged refrigerant tubing to component's quick-connect fittings. Install tubing to allow access to unit.

3.2 CONNECTIONS

A. Piping installation requirements are specified in other Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

1. Water Coil Connections: Comply with requirements specified in Section 232113 "Hydronic Piping" and Section 232116 Hydronic Piping Specialties." Connect hydronic piping to supply and return coil connections with shutoff-duty valve and union or flange on the supply connection and with throttling-duty valve and union or flange on the return connection.
2. Remote, Water-Cooled Condenser Connections: Comply with requirements specified in Section 232113 "Hydronic Piping" and Section 232116 Hydronic Piping Specialties." Connect hydronic piping to supply and return connections with shutoff-duty valve and union or flange on the supply connection and with throttling-duty valve and union or flange on the return connection.

B. Where piping is installed adjacent to unit, allow space for service and maintenance of unit.

C. Duct Connections: Duct installation requirements are specified in Section 233113 "Metal Ducts." Drawings indicate the general arrangement of ducts. Connect supply and return ducts to split-system air-conditioning units with flexible duct connectors. Flexible duct connectors are specified in Section 233300 "Air Duct Accessories."

3.3 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.

B. Perform tests and inspections.

1. Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

C. Tests and Inspections:

1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
2. Operational Test: After electrical circuitry has been energized, start units to

confirm proper motor rotation and unit operation.

3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

D. Remove and replace malfunctioning units and retest as specified above.

E. Prepare test and inspection reports.

3.4 STARTUP SERVICE

A. Engage a factory-authorized service representative to perform startup service.

1. Complete installation and startup checks in accordance with manufacturer's written instructions.

3.5 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain units.

END OF SECTION 23 81 26

SECTION 238129 - VARIABLE-REFRIGERANT-FLOW HVAC SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes: VRF HVAC systems.

1. VRF indoor units.
2. VRF outdoor units.
3. System controls.
4. System refrigerant and oil.
5. VRF system condensate drain piping.
6. System refrigerant piping.
7. Metal hangers and supports.
8. Metal strut support systems.
9. Fastener systems.
10. Rooftop-mounted strut support systems.
11. Equipment stands, outdoor type.
12. Piping and tubing insulation.
13. System control cable.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.3 ACTION SUBMITTALS

A. Product Data: For each specified system and assembly, including components and accessories.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for indoor and outdoor units.
2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
3. Include operating performance at design conditions and at extreme maximum and minimum outdoor ambient conditions.
4. Include description of system controllers, dimensions, features, control interfaces and connections, power requirements, and connections.
5. Include system operating sequence of operation in narrative form for each unique indoor- and outdoor-unit control.
6. Include description of control software features.
7. Include total refrigerant required and a comprehensive breakdown of refrigerant required by each system installed.
8. Include refrigerant type and data sheets showing compliance with requirements indicated.

9. For system design software.
10. Indicate location and type of service access.

B. Shop Drawings: For VRF HVAC systems.

1. Include plans, elevations, sections, and mounting details.
2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
3. Vibration Isolation Base Details: Detail fabrication including anchorages and attachments to structure and to supported equipment. Include adjustable motor bases, rails, and frames for equipment mounting.
4. Include diagrams and details of refrigerant piping and tubing showing installation requirements for manufacturer-furnished divided flow fittings.
5. Include diagrams for power, signal, and control wiring.

C. Samples for Initial Selection: For fully and partially exposed indoor units with factory finishes viewable by occupants.

1. Include a Sample for each unique finish with unit identification, detailed description of application, and cross-referenced floor plans showing locations.

D. Delegated Design Submittals:

1. Include design calculations for selecting vibration isolators and for designing vibration isolation bases.
2. Include design calculations with corresponding diagram of refrigerant piping and tubing sizing for each system installed.
3. Include design calculations with corresponding floor plans indicating that refrigerant concentration limits are within allowable limits of ASHRAE 15 and governing codes.
4. Include calculations showing that system travel distance for refrigerant piping and controls cabling are within horizontal and vertical travel distances set by manufacturer. Provide a comparison table for each system installed.

1.4 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Plans, elevations, sections, and details, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:

1. Suspended ceiling components.
2. Structural floors, roofs and associated members to which equipment, piping, ductwork, cables, and conduit will be attached.
3. Size and location of initial access modules for acoustical tile.
4. Wall-mounted controllers located in finished space showing relationship to light switches, fire-alarm devices, and other installed devices.
5. Size and location of access doors and panels installed behind walls and inaccessible ceilings for products installed behind walls and requiring access.
6. Items penetrating finished ceiling including the following:

a. Luminaires.
b. Air outlets and inlets.
c. Speakers.
d. Sprinklers.
e. Service access panels.

B. Product Certificates: For VRF HVAC system components.

C. Product Test Reports: Where tests are required, for each product, for tests performed by manufacturer and witnessed by a qualified testing agency or a qualified testing agency.

D. Source Quality Control Reports: For specified tests and inspections.

E. Field Quality Control Reports: For specified tests and inspections.

F. Qualification Statements:

1. For Installer: Certificate from VRF HVAC system manufacturer certifying that Installer has successfully completed prerequisite training administered by manufacturer for proper installation of systems, including but not limited to, equipment, piping, controls, and accessories indicated and furnished for installation.

a. Retain copies of Installer certificates on-site and make available on request.

2. For VRF HVAC system manufacturer.
3. For VRF HVAC system provider.

G. Sample Warranties: For specified special warranties.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For VRF HVAC systems.

B. Software and Firmware Operational Documentation:

1. Software operating and upgrade manuals.
2. Program Software Backup: On CD or DVD, USB media, or approved cloud storage platform, complete with data files.
3. Device address list.
4. Printout of software application and graphic screens.

1.6 QUALITY ASSURANCE

A. Manufacturer Qualifications:

1. Nationally recognized manufacturer of VRF HVAC systems and products.
2. Shipped VRF HVAC systems with similar requirements to those indicated for a

continuous period of five years within time of bid.

3. VRF HVAC systems and products that have been successfully tested and in use on at least three completed projects.
4. Having complete published catalog literature, installation, and operation and maintenance manuals for all products intended for use.
5. Having full-time in-house employees for the following:

    a. Product research and development.
    b. Product and application engineering.
    c. Product manufacturing, testing, and quality control.
    d. Technical support for system installation training, startup, commissioning, and troubleshooting of installations.
    e. Owner training.

B. Factory-Authorized Service Representative Qualifications:

1. Authorized representative of, and trained by, VRF HVAC system manufacturer.
2. In-place facility located within 60 miles of Project.
3. Demonstrated past experience with products being installed for period within three consecutive years before time of bid.
4. Demonstrated past experience on five projects of similar complexity, scope, and value.

    a. Each person assigned to Project must have demonstrated past experience.

5. Staffing resources of competent and experienced full-time employees that are assigned to execute work according to schedule.
6. Service and maintenance staff assigned to support Project during warranty period.
7. Product parts inventory to support ongoing system operation for a period of not less than five years after Substantial Completion.
8. VRF HVAC system manufacturer's backing to take over execution of Work if necessary to comply with requirements indicated. Include Project-specific written letter, signed by manufacturer's corporate officer, if requested.

C. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by VRF HVAC system manufacturer.

1. Each employee must be certified by manufacturer for proper installation of systems, including, but not limited to, equipment, piping, controls, and accessories indicated and furnished for installation.
2. Installer certification must be valid and current for duration of Project.
3. Retain copies of Installer certificates on-site and make available on request.
4. Each person assigned to Project must have demonstrated past experience.

    a. Demonstrated past experience with products being installed for period within three consecutive years before time of bid.
    b. Demonstrated past experience on five projects of similar complexity, scope, and value.

D. ISO Compliance: System equipment and components furnished by VRF HVAC system

manufacturer are to be manufactured in an ISO 9001 and ISO 14001 facility.

1.7 MOCKUPS

A. Build mockups to set quality standards for materials and execution.

1. Build mockups to show a finished installation for each of the following applications:

a. For each different indoor unit type with exposed surfaces viewable by occupants.

2. Mockups are to be operational.
3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Owner specifically approves such deviations by Change Order.
4. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.8 WARRANTY

A. Manufacturer's Warranty: Manufacturer agrees to repair or replace equipment and components that fail(s) in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Structural failures.
b. Faulty operation.
c. Deterioration of metals, metal finishes, and other materials beyond normal weathering and use.

2. Warranty Period:

a. For Compressor: Five year(s) from date of Substantial Completion.
b. For Parts, Including Controls: Five year(s) from date of Substantial Completion.
c. For Labor: Five year(s) from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professionalspecialist, as defined in Section 014000 "Quality Requirements," to design complete and operational VRF HVAC system(s).

1. Provide system refrigerant calculations.

a. Refrigerant concentration limits must be within allowable limits of ASHRAE 15 and governing codes.
b. Indicate compliance with manufacturer's maximum vertical and horizontal travel distances. Prepare a comparison table for each system showing calculated distances compared to manufacturer's maximum allowed distances.

2. Include a mechanical ventilation system and gas detection system as required to comply with ASHRAE 15 and governing codes.
3. System Refrigerant Piping and Tubing:

a. Arrangement: Arrange piping to interconnect indoor units and outdoor unit(s) in compliance with manufacturer requirements and requirements.
b. Routing: Conceal piping above ceilings and behind walls to maximum extent possible.
c. Sizing: Size piping system, using a software program acceptable to manufacturer, to provide performance requirements indicated. Consider requirements to accommodate future change requirements.

4. System Controls:

a. Network arrangement.
b. Network interface with other building systems.
c. Product selection.
d. Sizing.

B. Service Access:

1. Provide and document service access requirements.
2. Locate equipment, system isolation valves, and other system components that require service and inspection in easily accessible locations. Avoid locations that are difficult to access if possible.
3. Where serviceable components are installed behind walls and above inaccessible ceilings, provide finished assembly with access doors or panels to gain access. Properly size the openings to allow for service, removal, and replacement.
4. If less than full and unrestricted access is provided, locate components within an **18-inch** reach of the finished assembly.
5. Where ladder access is required to service elevated components, provide an installation that provides for sufficient access within ladder manufacturer's written instructions for use.
6. Comply with OSHA regulations.

C. System Design and Installation Requirements:

1. Design and install systems indicated in accordance with manufacturer's written instructions.
2. Where manufacturer's requirements differ from requirements indicated, contact Architect for direction. The most stringent requirements should apply unless otherwise directed in writing by Architect.

D. Isolation of Equipment: Provide isolation valves to isolate each indoor unit and outdoor unit for service, removal, and replacement without interrupting system operation.

E. System Turndown: Stable operation down to 20 percent of outdoor-unit capacity.

F. System Auto Refrigerant Charge: Each system is to have an automatic refrigerant charge function to ensure the proper amount of refrigerant is installed in system.

G. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

H. AHRI Compliance: System and equipment performance certified in accordance with AHRI 1230 and products listed in AHRI directory.

I. ASHRAE Compliance:

1. ASHRAE 15: For safety code for mechanical refrigeration.
2. ASHRAE 62.1: For indoor air quality.
3. ASHRAE 135: For control network protocol with remote communication.
4. ASHRAE/IES 90.1: For system and component energy efficiency.

J. UL Compliance: Comply with UL 1995.

K. Outdoor Conditions:

1. Suitable for outdoor ambient conditions encountered.

a. Design equipment and supports to withstand wind loads of governing code.
b. Provide corrosion-resistant coating for components and supports where located in coastal or industrial climates that are known to be harmful to materials and finishes.

L. Sound Performance: Sound levels generated by operating HVAC equipment must be within requirements indicated.

1. Indoor: See Drawings.
2. Outdoor: See Drawings.

M. Thermal Movements: Allow for controlled thermal movements from ambient, surface, and system temperature changes.

N. Capacities and Characteristics: As indicated on Drawings.

2.2 VRF HVAC SYSTEMS

A. Manufacturers: Subject to compliance with requirements, provide products by the following:

1. Carrier Global Corporation
2. Daikin Applied

3. LG Electronics USA, Inc.; LG Electronics Inc.
4. Mitsubishi Electric Cooling and Heating
5. Trane Inc.

B. Source Limitations: Obtain products from single source from single manufacturer including, but not limited to, the following:

1. Indoor and outdoor units, including accessories.
2. Controls and software.
3. HRCUs.
4. Refrigerant isolation valves.
5. Specialty refrigerant pipe fittings.

C. System Description: Direct-expansion (DX) VRF HVAC system(s) with variable capacity in response to varying cooling and heating loads. System is to consist of multiple indoor units, outdoor unit(s), piping, controls, and electrical power to make complete operating system(s) complying with requirements indicated.

1. Two-pipe system design.
2. System(s) operation, heat pump as indicated on Drawings.
3. Each system has one refrigerant circuit shared by all indoor units connected to system.

D. VRF Indoor Units:

1. VRF Indoor Unit - Concealed, Ceiling-Mounted Units for Ducting:

a. Description: Factory-assembled and -tested complete unit with components, piping, wiring, and controls required for mating to ductwork, piping, power, and controls field connections.
b. Cabinet:

1) Material: Galvanized or painted steel.
2) Insulation: Manufacturer's standard internal insulation, complying with ASHRAE 62.1, to provide thermal resistance and prevent condensation.
3) Duct Connections: Extended collar or flange, or designated exterior cabinet surface, designed for attaching field-installed ductwork.
4) Mounting: Manufacturer-designed provisions for field installation.
5) Internal Access: Removable panels or hinged doors of adequate size for field access to internal components for inspection, cleaning, service, and replacement.

c. DX Coil Assembly:

1) Coil Casing: Aluminum, galvanized, or stainless steel.
2) Coil Fins: Aluminum, mechanically bonded to tubes, with arrangement required by performance.
3) Coil Tubes: Copper, of diameter and thickness required by performance.
4) Expansion Valve: Electronic modulating type with linear or

proportional characteristics.
5) Unit Internal Tubing: Copper tubing with brazed joints.
6) Unit Internal Tubing Insulation: Manufacturer's standard insulation, of thickness to prevent condensation.
7) Field Piping Connections: Manufacturer's standard.
8) Factory Charge: Dehydrated air or nitrogen.
9) Testing: Factory pressure tested and verified to be without leaks.

d. Drain Assembly:

1) Pan: Non-ferrous material, with bottom sloped to low point drain connection.
2) Condensate Removal: Unit-mounted pump or other integral lifting mechanism, capable of lifting drain water to an elevation above top of cabinet.
3) Field Piping Connection: Non-ferrous material with threaded NPT.

e. Fan and Motor Assembly:

1) Fan(s):

a) Direct-drive arrangement.
b) Single or multiple fans connected to a common motor shaft and driven by a single motor.
c) Fabricated from non-ferrous components or ferrous components with corrosion-resistant finish.
d) Wheels statically and dynamically balanced.

2) Motor: Brushless dc or electronically commutated with permanently lubricated bearings.
3) Motor Protection: Integral protection against thermal, overload, and voltage fluctuations.
4) Speed Settings and Control: Two (low, high), three (low, medium, high), or more than three speed settings or variable speed with a speed range of least 50 percent.
5) Vibration Control: Integral isolation to dampen vibration transmission.

f. Filter Assembly:

1) Access: Bottom, side, or rear to accommodate field installation without removing ductwork and to accommodate filter replacement without need for tools.
2) Efficiency: ASHRAE 52.2, MERV 7.
3) Media:

a) Washable: Manufacturer's standard filter with antimicrobial treatment.

g. Unit Accessories:

1) Outdoor Air Ventilation Kit: Connection, motorized damper, and

control sized to allow sequence of operation indicated on Drawings.

2) Remote Room Temperature Sensor Kit: Wall-mounted, hardwired room temperature sensor kit for use in rooms that do not have room temperature measurement.

h. Unit Controls:

1) Provide manufacturer wired controller at each indoor unit to run both indoor and outdoor unit. Must be by same manufacturer as the HVAC system it controls. Provide capabilities for central management. Provide an add to the cost of the HVAC system for this type of remote control for the entirety of the units provided.
2) Enclosure: Metal, suitable for indoor locations.
3) Factory-Installed Controller: Configurable digital control.
4) Factory-Installed Sensors:

a) Unit inlet air temperature.
b) Coil entering refrigerant temperature.
c) Coil leaving refrigerant temperature.

5) Features and Functions:

a) Self-diagnostics.
b) Time delay.
c) Auto-restart.
d) External static pressure control.
e) Auto operation mode.
f) Manual operation mode.
g) Filter service notification.
h) Power consumption display.
i) Drain-assembly, high-water-level safety shutdown and notification.
j) Run test switch.

6) Communication: Network communication with other indoor and outdoor units.
7) Cable and Wiring: Manufacturer's standard with each connection labeled and corresponding to a unit-mounted wiring diagram.
8) Field Connection: Manufacturer's standard with each connection labeled and corresponding to a unit-mounted wiring diagram.

i. Unit Electrical:

1) Enclosure: Metal, suitable for indoor locations.
2) Field Connection: Single-point connection to power unit and integral controls.
3) Disconnecting Means: Factory-mounted circuit breaker or switch.
4) Control Transformer: Manufacturer's standard. Coordinate requirements with field power supply.
5) Wiring: Manufacturer's standard with each connection labeled and corresponding to a unit-mounted wiring diagram.

6) Raceways: Enclose line voltage wiring in metal raceways.

2. VRF Indoor Unit - Exposed, Wall Mounted:

a. Description: Factory-assembled and -tested complete unit with components, piping, wiring, and controls required for mating to piping, power, and controls field connections.
b. Cabinet:

1) Material: Painted steel, or coated steel frame covered by a plastic cabinet, with an architectural acceptable finish suitable for tenant occupancy on exposed surfaces.
2) Insulation: Manufacturer's standard internal insulation, complying with ASHRAE 62.1, to provide thermal resistance and prevent condensation.
3) Mounting: Manufacturer-designed provisions for field installation.
4) Internal Access: Removable panels of adequate size for field access to internal components for inspection, cleaning, service, and replacement.

c. DX Coil Assembly:

1) Coil Casing: Aluminum, galvanized, or stainless steel.
2) Coil Fins: Aluminum, mechanically bonded to tubes, with arrangement required by performance.
3) Coil Tubes: Copper, of diameter and thickness required by performance.
4) Expansion Valve: Electronic modulating type with linear or proportional characteristics.
5) Unit Internal Tubing: Copper tubing with brazed joints.
6) Unit Internal Tubing Insulation: Manufacturer's standard insulation, of thickness to prevent condensation.
7) Field Piping Connections: Manufacturer's standard.
8) Factory Charge: Dehydrated air or nitrogen.
9) Testing: Factory pressure tested and verified to be without leaks.

d. Drain Assembly:

1) Pan: Non-ferrous material, with bottom sloped to low point drain connection.
2) Condensate Removal: Gravity.

a) If a floor drain is not available at unit, provide unit with field-installed condensate pump accessory.

3) Field Piping Connection: Non-ferrous material with threaded NPT.

e. Fan and Motor Assembly:

1) Fan(s):

a) Direct-drive arrangement.
b) Single or multiple fans connected to a common motor shaft and driven by a single motor.
c) Fabricated from non-ferrous components or ferrous components with corrosion protection finish.
d) Wheels statically and dynamically balanced.

2) Motor: Brushless dc or electronically commutated with permanently lubricated bearings.
3) Motor Protection: Integral protection against thermal, overload, and voltage fluctuations.
4) Speed Settings and Control: Two (low, high), three (low, medium, high), or more than three speed settings or variable speed with a speed range of least 50 percent.
5) Vibration Control: Integral isolation to dampen vibration transmission.

f. Filter Assembly:

1) Access: Front, to accommodate filter replacement without the need for tools.
2) Efficiency: MERV-7.
3) Washable Media: Manufacturer's standard filter with antimicrobial treatment.

g. Grille Assembly: Manufacturer's standard discharge grille with field-adjustable air pattern mounted in top or front face of unit cabinet.
h. Unit Accessories:

1) Remote Room Temperature Sensor Kit: Wall-mounted, hardwired room temperature sensor kit for use in rooms that do not have room temperature measurement.
2) Condensate Pump: Integral reservoir and control with electrical power connection through unit power.

i. Unit Controls:

1) Provide manufacturer wired controller at each indoor unit to run both indoor and outdoor unit. Must be by same manufacturer as the HVAC system it controls. Provide capabilities for central management. Provide an add to the cost of the HVAC system for this type of remote control for the entirety of the units provided.
2) Enclosure: Manufacturer's standard, and suitable for indoor locations.
3) Factory-Installed Controller: Configurable digital control.
4) Factory-Installed Sensors: Unit inlet air temperatureCoil leaving refrigerant temperature.
5) Field-Customizable I/O Capability:

a) Analog Inputs: Two for use in customizable control strategies.
b) Digital Inputs: Two for use in customizable control strategies.
c) Digital Outputs: Two for use in customizable control strategies.

6) Features and Functions: Self-diagnostics, time delay, auto-restart, auto operation mode, filter service notification, power consumption display, drain-assembly, high-water-level safety shutdown and notification, run test switch.
7) Communication: Network communication with other indoor units and outdoor unit(s).
8) Cable and Wiring: Manufacturer's standard with each connection labeled and corresponding to a unit-mounted wiring diagram.
9) Field Connection: Manufacturer's standard with each connection labeled and corresponding to a unit-mounted wiring diagram.

j. Unit Electrical:

1) Enclosure: Manufacturer's standard, and suitable for indoor locations.
2) Field Connection: Single-point connection to power entire unit and integral controls.
3) Disconnecting Means: Factory-mounted circuit breaker or switch, complying with NFPA 70.
4) Control Transformer: Manufacturer's standard. Coordinate requirements with field power supply.
5) Wiring: Manufacturer's standard with each connection labeled and corresponding to a unit-mounted wiring diagram.
6) Raceways: Enclose line voltage wiring in metal raceways to comply with NFPA 70.

E. VRF Outdoor Units:

1. VRF Outdoor Unit - Air-Source Heat Pump:

a. Description: Factory-assembled and -tested complete unit with components, piping, wiring, and controls required for mating to piping, power, and controls field connections.

1) Specially designed for use in systems with either all heating or all cooling demands, but not for use in systems with simultaneous heating and cooling.
2) Systems are to consist of one unit, or multiple unit modules that are designed by variable refrigerant system manufacturer for field interconnection to make a single refrigeration circuit that connects multiple indoor units.
3) All units installed are to be from the same product development generation.

b. Cabinet:

1) Galvanized steel and coated with a corrosion-resistant finish.

a) Coating with documented salt spray test performance of 1000 hours in accordance with ASTM B117 surface scratch test (SST) procedure.

2) Mounting: Manufacturer-designed provisions for field installation.
3) Internal Access: Removable panels or hinged doors of adequate size for field access to internal components for inspection, cleaning, service, and replacement.

c. Compressor and Motor Assembly:

1) One or more positive-displacement, direct-drive and hermetically sealed scroll compressor(s) with inverter drive and turndown to 15 percent of rated capacity.
2) Protection: Integral protection against the following:

a) High refrigerant pressure.
b) Low oil level.
c) High oil temperature.
d) Thermal and overload.
e) Voltage fluctuations.
f) Phase failure and phase reversal.
g) Short cycling.

3) Speed Control: Variable to automatically maintain refrigerant suction and condensing pressures while varying refrigerant flow to satisfy system cooling and heating loads.
4) Vibration Control: Integral isolation to dampen vibration transmission.
5) Oil management system to ensure safe and proper lubrication over entire operating range.
6) Crankcase heaters with integral control to maintain safe operating temperature.
7) Fusible plug.

d. Condenser Coil Assembly:

1) Plate Fin Coils:

a) Casing: Aluminum, galvanized, or stainless steel.
b) Fins: Aluminum or copper, mechanically bonded to tubes, with arrangement required by performance.
c) Tubes: Copper, of diameter and thickness required by performance.

2) Aluminum Microchannel Coils:

a) Series of flat tubes containing a series of multiple, parallel-flow microchannels layered between refrigerant header manifolds.
b) Single- or multiple-pass arrangement.
c) Construct fins, tubes, and header manifolds of aluminum alloy.

3) Coating: None.
4) Hail Protection: Provide condenser coils with louvers, baffles, or hoods to protect against hail damage.

e. Condenser Fan and Motor Assembly:

1) Fan(s): Propeller type.

a) Direct-drive arrangement.
b) Fabricated from non-ferrous components or ferrous components with corrosion protection finish to match performance indicated for condenser coil.
c) Dynamically and statically balanced.

2) Fan Guards: Removable safety guards complying with OSHA regulations. If using metal materials, coat with corrosion-resistant coating to match performance indicated for condenser coil.
3) Motor(s): Brushless dc or electronically commutated with permanently lubricated bearings and rated for outdoor duty.
4) Motor Protection: Integral protection against thermal, overload, and voltage fluctuations.
5) Speed Settings and Control: Variable speed with a speed range of least 75 percent.
6) Vibration Control: Integral isolation to dampen vibration transmission.

f. Drain Pan: If required by manufacturer's design, provide unit with non-ferrous drain pan with bottom sloped to a low point drain connection.
g. Unit Controls:

1) Enclosure: Manufacturer's standard, and suitable for unprotected outdoor locations.
2) Factory-Installed Controller: Configurable digital control.
3) Factory-Installed Sensors:

a) Refrigerant suction temperature.
b) Refrigerant discharge temperature.
c) Outdoor air temperature.
d) Refrigerant high pressure.
e) Refrigerant low pressure.
f) Oil level.

h. Features and Functions: Self-diagnostics, time delay, auto-restart, fuse protection, auto operation mode, manual operation mode, night setback control, power consumption display, run test switch, equalize run time between multiple same components.
i. Communication: Network communication with indoor units and other outdoor unit(s).
j. Cable and Wiring: Manufacturer's standard with each connection labeled and corresponding to a unit-mounted wiring diagram.
k. Field Connection: Manufacturer's standard with each connection labeled and corresponding to a unit-mounted wiring diagram.
l. Unit Electrical:

1) Enclosure: Metal, similar to enclosure, and suitable for unprotected outdoor locations.

2) Field Connection: Single-point connection to power entire unit and integral controls.
3) Disconnecting Means: Factory-mounted circuit breaker or switch, complying with NFPA 70.
4) Control Transformer: Manufacturer's standard. Coordinate requirements with field power supply.
5) Wiring: Manufacturer's standard with each connection labeled and corresponding to a unit-mounted wiring diagram.
6) Raceways: Enclose line voltage wiring in metal raceways to comply with NFPA 70.

m. Unit Hardware: Zinc-plated steel, or stainless steel. Coat exposed surfaces with additional corrosion-resistant coating if required to prevention corrosion when exposed to salt spray test for 1000 hours in accordance with ASTM B117.
n. Unit Piping:

1) Unit Tubing: Copper tubing with brazed joints.
2) Unit Tubing Insulation: Manufacturer's standard insulation, of thickness to prevent condensation.
3) Field Piping Connections: Manufacturer's standard.
4) Factory Charge: Dehydrated air or nitrogen.
5) Testing: Factory pressure tested and verified to be without leaks.

F. System Controls:

1. General Requirements:

a. Network: Indoor units and outdoor units shall include integral controls and connect through a TIA-485A or manufacturer-selected control network.
b. Network Communication Protocol: open control communication between interconnected units.
c. Integration with Building Automation System: ASHRAE 135, BACnet IP and certified by BACnet Testing Lab (BTL), including the following:

1) Ethernet connection via RJ-45 connectors and port with transmission at 100 Mbps or higher.
2) Integration devices are to be connected to local uninterruptible power supply unit(s) to provide at least 5 minutes of battery backup operation after a power loss.
3) Integration is to include control monitoring scheduling change of value notifications.

d. Operator Interface:

1) Operator interface with system and unit controls is to be through the following:

a) Operator interfaces integral to controllers.
b) Owner-furnished PC connected to central controller(s).
c) Web interface through web browser software.

d) Integration with Building Automation System.

2) Users interface with controllers for indoor units control to extent privileges are to be enabled. Control features available to users are to include the following:

a) On/off control.
b) Temperature set-point adjustment.

2. VRF HVAC System Operator Software for PC:

a. Software offered by VRF HVAC system manufacturer is to provide system operators with ability to monitor and control VRF HVAC system(s) from a single dedicated Owner-furnished PC.
b. Software is to provide operator with a graphic user interface to allow monitoring and control of multiple central controllers from a single device location through point-and-click mouse exchange.
c. Plan views are to show building plans with location of indoor units and identification superimposed on plans.
d. Controls operation mode of indoor units as individual units, by selected groups of indoor units, or as collection of all indoor units. Operation modes available through central controller are to match those operation modes of controllers for indoor units.
e. Schedules operation of indoor units as individual units, by selected groups of indoor units, or as collection of all indoor units. Schedules daily, weekly, and annual events.
f. Changes operating set points of indoor units as individual units, by selected groups of indoor units, or as collection of all indoor units.
g. Optimized start feature to start indoor units before scheduled time to reach temperature set-point at scheduled time based on operating history.
h. Night setback feature to operate indoor units at energy-conserving heating and cooling temperature set-points during unoccupied periods.
i. Supports Multiple Languages: English.
j. Supports Imperial and Metric Temperature Units: Fahrenheit.
k. Displays service notifications and error codes.
l. Monitors and displays up to 3000 item error history and 10000 item operation history for regular reporting and further archiving.
m. Monitors and displays cumulative operating time of indoor units.
n. Able to disable and enable operation of individual controllers for indoor units.
o. Information displayed on individual controllers shall also be available for display.
p. Information Displayed for Outdoor Units:

1) Refrigerant high and low pressures and percent capacity.

3. Central Controllers:

a. Centralized control for all indoor and outdoor units from a single central controller location.

1) Include multiple interconnected controllers as required.

b. Controls operation mode of indoor units as individual units, by selected groups of indoor units, or as collection of all indoor units. Operation modes available through central controller are to match those operation modes of controllers for indoor units.
c. Schedule operation of indoor units as individual units, by selected groups of indoor units, or as collection of all indoor units.

1) Sets schedule for daily, weekly, and annual events.
2) Schedule options available through central controller are to at least include the schedule options of controllers for indoor units.

d. Changes operating set points of indoor units as individual units, by selected groups of indoor units, or as collection of all indoor units.
e. Optimized start feature to start indoor units before scheduled time to reach temperature set-point at scheduled time based on operating history.
f. Night setback feature to operate indoor units at energy-conserving heating and cooling temperature set-points during unoccupied periods.
g. Service diagnostics tool.
h. Able to disable and enable operation of individual controllers for indoor units.
i. Information displayed on individual controllers is to also be available for display through central controller.
j. Information Displayed for Outdoor Units:

1) Refrigerant high and low pressures and percent capacity.

k. Multiple RJ-45 ports for direct connection to a local PC and an Ethernet network switch.
l. Operator interface through a backlit, high-resolution color display touch panel and web accessible through standard web browser software.

4. Wired Controllers for Indoor Units:

a. Single controller capable of controlling multiple indoor units as group.
b. Auto Timeout Touch Screen LCD: Timeout duration shall be adjustable.
c. Multiple Language: English.
d. Temperature Units: Fahrenheit.
e. On/Off: Turns indoor unit on or off.
f. Hold: Hold operation settings until hold is released.
g. Operation Mode: Cool, Heat, Auto, Dehumidification, Fan Only, and Setback.
h. Temperature Display: 1-degree increments.
i. Temperature Set-Point: Separate set points for Cooling, Heating, and Setback modes. Adjustable in 1-degree increments between 60-80.
j. Relative Humidity Display: 1 percent increments.
k. Relative Humidity Set-Point: Adjustable in 1 percent increments between.
l. Fan Speed Setting: Select between available options furnished with the unit.
m. Airflow Direction Setting: If applicable to unit, select between available

options furnished with the unit.

n. Seven-day programmable operating schedule with up to five events per day. Operations are to include On/Off, Operation Mode, and Temperature Set-Point.
o. Auto Off Timer: Operates unit for an adjustable time duration and then turns unit off.
p. Occupancy detection.
q. Service Notification Display: "Filter".
r. Service Run Tests: Limit use by service personnel to troubleshoot operation.
s. Error Code Notification Display: Used by service personnel to troubleshoot abnormal operation and equipment failure.
t. User and Service Passwords: Capable of preventing adjustments by unauthorized users.
u. Setting stored in nonvolatile memory to ensure that settings are not lost if power is lost. Battery backup for date and time only.
v. Low-voltage power required for controller is to be powered through non-polar connections to indoor unit.

5. Wireless Controllers for Indoor Units:

a. Wireless Communication:

1) Controller communicates to remote-mounted receiver that is wired to indoor unit(s).

a) Include receivers with wireless controllers as required to complete installation.
b) Low-voltage power required for receivers shall be powered through non-polar connections to indoor unit.

2) One wireless controller is to be capable of communicating with one or multiple receivers to control one or multiple indoor units as a group.

b. Controller Battery Life: Three years.
c. Auto Timeout Touch Screen LCD: Timeout duration shall be adjustable.
d. Multiple Language: English.
e. Temperature Units: Fahrenheit.
f. On/Off: Turns indoor unit on or off.
g. Hold: Hold operation settings until hold is released.
h. Operation Mode: Cool, Heat, Auto, Dehumidification, Fan Only, and Setback.
i. Temperature Display: 1-degree increments.
j. Temperature Set-Point: Separate set points for Cooling, Heating, and Setback modes. Adjustable in 1-degree increments between 60-80.
k. Relative Humidity Display: 1 percent increments.
l. Relative Humidity Set-Point: Adjustable in 1 percent increments between 45-60.
m. Fan Speed Setting: Select between available options furnished with the unit.
n. Airflow Direction Setting: If applicable to unit, select between available

options furnished with the unit.

o. Seven-day programmable operating schedule with up to five events per day. Operations shall include On/Off, Operation Mode, and Temperature Set-Point.
p. Auto Off Timer: Operates unit for an adjustable time duration and then turns unit off.
q. Occupancy detection.
r. Service Notification Display: "Filter".
s. Service Run Tests: Limit use by service personnel to troubleshoot operation.
t. Error Code Notification Display: Used by service personnel to troubleshoot abnormal operation and equipment failure.
u. User and Service Passwords: Capable of preventing adjustments by unauthorized users.
v. Setting stored in non-volatile memory to ensure that settings are not lost if power is lost. Battery for date and time only.

G. System Refrigerant and Oil:

1. Refrigerant: As required by VRF HVAC system manufacturer for system to comply with performance requirements indicated.

a. Classification: ASHRAE 34.

2. Oil: As required by VRF HVAC system manufacturer and to comply with performance requirements indicated.

2.3 VRF SYSTEM CONDENSATE DRAIN PIPING

A. See Section 232113 "Hydronic Piping" for VRF system condensate drain piping.

B. Copper Tube:

1. Drawn-Temper Tubing: Complying with ASTM B88, Type L or Type DWV complying with ASTM B306.
2. Wrought-Copper Fittings: ASME B16.22.
3. Wrought-Copper Unions: ASME B16.22.
4. Solder Filler Metals: ASTM B32, lead-free alloys, and water-flushable flux complying with ASTM B813.

C. CPVC Plastic Pipe: Complying with ASTM F441/F441M, Schedule 40, with socket-type pipe fittings complying with ASTM F438 and solvent cement complying with ASTM F493.

D. PVC Plastic Pipe: Complying with ASTM D1785, Schedule 40, with socket-type pipe fittings complying with ASTM D2466 and solvent cement in accordance with ASTM D2564, primer complying with ASTM F656.

2.4 SYSTEM HYDRONIC PIPING

A. Comply with requirements in Section 232113 "Hydronic Piping" for system piping requirements.

2.5 SYSTEM REFRIGERANT PIPING

A. Comply with requirements in Section 232300 "Refrigerant Piping" for system piping requirements.

B. Refrigerant Piping, Valves, and Fittings:

1. Copper Tube: ASTM B280, Type ACR.
2. Wrought-Copper Fittings, Brazed Joints: ASME B16.50.
3. Brazing Filler Metals: AWS A5.8/A5.8M.
4. Refrigerant Tubing Kits:

    a. Furnished by VRF HVAC system manufacturer.
    b. Factory-rolled and -bundled, soft-copper tubing with tubing termination fittings at each end.
    c. Standard one-piece length for connecting to indoor units.
    d. Pre-insulated with flexible elastomeric insulation of thickness to comply with governing energy code and sufficient to eliminate condensation.
    e. Factory Charge: Dehydrated air or nitrogen.

C. Divided-Flow Specialty Fittings: Where required by VRF HVAC system manufacturer for proper system operation, VRF HVAC system manufacturer is to furnish specialty fittings with identification and instructions for proper installation by Installer.

D. Refrigerant Isolation Ball Valves: Uni-body full port design, rated for maximum system temperature and pressure, and factory tested under pressure to ensure tight shutoff. Designed for valve operation without removing seal cap.

1. Seals: Compatible with system refrigerant and oil. Seal service life of at least 20 years.
2. Valve Connections: Flare or sweat, depending on size.

2.6 FASTENER SYSTEMS

A. Powder-Actuated Fasteners: Threaded, zinc-coated steel stud, for use in hardened portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

B. Mechanical-Expansion Anchors: Insert-wedge-type anchors, for use in hardened portland cement concrete; with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

1. Indoor Applications: Zinc-coated or stainless steel.
2. Outdoor Applications: Stainless steel.

2.7 ROOFTOP-MOUNTED STRUT SUPPORT SYSTEMS

A. Strut Support System - Rooftop-Mounted Pipe Stand, Curb-Mounted Type: Shop- or field-fabricated pipe supports made from structural-steel shapes, continuous-thread rods, and rollers, for mounting on permanent stationary roof curb.

2.8 EQUIPMENT STANDS, OUTDOOR TYPE

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. DiversiTech Corp.
2. MIRO Industries Inc.
3. RectorSeal HVAC; a CSW Industrials Company

B. Description: Individual foot supports with elevated adjustable channel cross bars and clamps/fasteners/bolts for ground or roof-supported outdoor equipment components, without roof membrane penetration, in a prefabricated system that can be modularly assembled on-site.

C. Foot Material: Rubber or polypropylene.

D. Rails Material: Hot-dip galvanized carbon steel.

E. Wind/Sliding Load Resistance: Up to 140 mph minimum.

2.9 MISCELLANEOUS SUPPORT MATERIALS

A. Grout: ASTM C1107, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink and nonmetallic grout; suitable for interior and exterior applications.

1. Properties: Nonstaining, noncorrosive, and nongaseous.
2. Design Mix: **5000 psi**, 28-day compressive strength.

B. Structural Steel: ASTM A36/A36M, carbon steel plates, shapes, and bars; galvanized.

C. Threaded Rods: Continuously threaded. Zinc-plated steel or galvanized steel for indoor applications and stainless steel for outdoor applications. Mating nuts and washers of similar material as rods.

2.10 SYSTEM CONTROL CABLE

A. Cable Rating: Listed and labeled for application in accordance with NFPA 70.

1. Flame Travel and Smoke Density in Plenums: As determined by testing identical products in accordance with NFPA 262, by a qualified testing agency. Identify products for installation in plenums with appropriate markings of applicable testing agency.

a. Flame Travel Distance: **60 inches** or less.
b. Peak Optical Smoke Density: 0.5 or less.
c. Average Optical Smoke Density: 0.15 or less.

2. Flame Travel and Smoke Density for Riser Cables in Non-Plenum Building Spaces: As determined by testing identical products in accordance with UL 1666.
3. Flame Travel and Smoke Density for Cables in Non-Riser Applications and Non-Plenum Building Spaces: As determined by testing identical products in accordance with UL 1685.

B. Low-Voltage Control Cabling:

1. Paired Cable: NFPA 70, Type CMG.

a. One pair, twisted, 16 AWG, stranded (19x29) or 18 AWG, stranded (19x30) tinned-copper conductors as required by VRF HVAC system manufacturer.
b. PVC insulation.
c. Braided or foil shielded.
d. PVC jacket.
e. Flame Resistance: Comply with UL 1685.

2. Plenum-Rated, Paired Cable: NFPA 70, Type CMP.

a. One pair, twisted, 16 AWG, stranded (19x29) or 18 AWG, stranded (19x30) tinned-copper conductors as required by VRF HVAC system manufacturer.
b. PVC insulation.
c. Braided or foil shielded.
d. PVC jacket.
e. NFPA 262 includes the standard flame-resistance test criteria in common use for cables and conductors.
f. Flame Resistance: Comply with NFPA 262.

C. TIA-485A Network Cabling:

1. Standard Cable: NFPA 70, Type CMG.

a. Paired, two pairs, twisted, 22 AWG, stranded (7x30) tinned-copper conductors.
b. PVC insulation.
c. Unshielded.
d. PVC jacket.
e. Flame Resistance: Comply with UL 1685.

2. Plenum-Rated Cable: NFPA 70, Type CMP.

a. Paired, two pairs, 22 AWG, stranded (7x30) tinned-copper conductors.
b. Fluorinated ethylene propylene insulation.
c. Unshielded.
d. Fluorinated ethylene propylene jacket.
e. NFPA 262 includes the standard flame-resistance test criteria in common use for cables and conductors.

f. Flame Resistance: NFPA 262.

D. Ethernet Network Cabling: TIA-568.2-D Category6a cable with RJ-45 connectors.

1. Description: Four-pair, balanced-twisted pair cable, certified to meet transmission characteristics of category cable indicated.
2. Conductors: 100-ohm, 23 AWG solid copper.
3. Shielding: Shielded twisted pairs (FTP).
4. Cable Rating: By application.
5. Jacket: Yellow thermoplastic.

E. Comply with requirements in Section 260533.13 "Conduits for Electrical Systems" for cable raceways.

2.11 MATERIALS

A. Steel:

1. ASTM A36/A36M for carbon structural steel.
2. ASTM A568/A568M for steel sheet.

B. Stainless Steel:

1. Manufacturer's standard grade for casing.
2. Manufacturer's standard type, ASTM A240/A240M for bare steel exposed to airstream or moisture.

C. Galvanized Steel: ASTM A653/A653M.

D. Aluminum: ASTM B209.

E. Comply with Section 230546 "Coatings for HVAC" for corrosion-resistant coating.

2.12 SOURCE QUALITY CONTROL

A. Factory Tests: Test and inspect factory-assembled equipment.

1. Equipment will be considered defective if it does not pass tests and inspections.

B. Prepare test and inspection reports for historical record. Submit reports only if requested.

PART 3 - EXECUTION

3.1 INSTALLATION OF VRF HVAC SYSTEMS, GENERAL

A. Clearance:

1. Maintain manufacturer's recommended clearances for service and maintenance.
2. Maintain clearances required by governing code.

B. Loose Components: Install components, devices, and accessories furnished by manufacturer, with equipment, that are not factory mounted.

1. Loose components are to be installed by manufacturer's service representative or system Installer under supervision of manufacturer's service representative.

C. Equipment Restraint Installation: Install equipment with seismic-restraint device. Comply with requirements for seismic-restraint devices specified in Section 230548 "Vibration and Seismic Controls for HVAC."

3.2 INSTALLATION OF VRF HVAC SYSTEMS

A. Installation of VRF Indoor Units:

1. Install units to be level and plumb while providing a neat and finished appearance.
2. Unless otherwise required by VRF HVAC system manufacturer, support ceiling-mounted units from structure above using threaded rods; minimum rod size of **3/8 inch**.
3. Adjust supports of exposed and recessed units to draw units tight to adjoining surfaces.
4. Protect finished surfaces of ceilings, floors, and walls that come in direct contact with units. Refinish or replaced damaged areas after units are installed.
5. In rooms with ceilings, conceal piping and tubing, controls, and electrical power serving units above ceilings.
6. In rooms without ceiling, arrange piping and tubing, controls, and electrical power serving units to provide a neat and finished appearance.
7. Provide lateral bracing if needed to limit movement of suspended units to not more than 0.25 inch.
8. For floor- and wall-mounted units that are exposed, conceal piping and tubing, controls, and electrical power serving units within walls.
9. Floor-mounted units located in mechanical rooms.
10. Install floor-mounted units on support structure indicated on Drawings.
11. Install floor-mounted units on cast-in-place concrete equipment bases. Comply with requirements for equipment bases and foundations specified in Section 033000 "Cast-in-Place Concrete."
12. Attachment: Install hardware for proper attachment to supported equipment.
13. Grouting: Place grout under equipment supports and make bearing surface smooth.

B. Installation of Duct, Accessories, and Air Outlets:

1. Where installing ductwork adjacent to equipment, allow space for service and maintenance.
2. Comply with requirements for metal ducts specified in Section 233113 "Metal Ducts."
3. Comply with requirements for nonmetal ducts specified in Section 233116

"Nonmetal Ducts."
4. Comply with requirements for air duct accessories specified in Section 233300 "Air Duct Accessories."
5. Comply with requirements for flexible ducts specified in Section 233346 "Flexible Ducts."
6. Comply with requirements for air diffusers specified in Section 233713.13 "Air Diffusers."
7. Comply with requirements for registers and grilles specified in Section 233713.23 "Registers and Grilles."

C. Installation of VRF Outdoor Units:

1. Install units to be level and plumb while providing a neat and finished appearance.
2. Install outdoor units on support structures indicated on Drawings.
3. Pad-Mounted Installations: Install outdoor units on cast-in-place concrete equipment bases. Comply with requirements for equipment bases and foundations specified in Section 033000 "Cast-in-Place Concrete."

    a. Attachment: Install anchor bolts to elevations required for proper attachment to supported equipment.
    b. Grouting: Place grout under equipment supports and make bearing surface smooth.

4. Roof-Mounted Installations: Install outdoor units on equipment supports specified in Section 077200 "Roof Accessories." Anchor units to supports with removable, stainless steel fasteners.

3.3 INSTALLATION OF PIPING, GENERAL

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping and tubing systems. Install piping and tubing as indicated unless deviations to layout are approved on coordination drawings.

B. Install piping and tubing in concealed locations unless otherwise indicated and except in equipment rooms and service areas.

C. Install piping and tubing at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

D. Install piping and tubing above accessible ceilings to allow sufficient space for ceiling panel removal.

E. Install piping and tubing to permit valve servicing.

F. Install piping and tubing at indicated slopes.

G. Install piping and tubing free of sags.

H. Install fittings for changes in direction and branch connections.

I. Install piping and tubing to allow application of insulation.

J. Install groups of pipes and tubing parallel to each other, spaced to permit applying insulation with service access between insulated piping and tubing.

K. Install sleeves for piping and tubing penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 230500 "Common Work Results for HVAC."

L. Install escutcheons for piping and tubing penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 230500 "Common Work Results for HVAC."

3.4 INSTALLATION OF VRF SYSTEM CONDENSATE DRAIN PIPING

A. General Requirements for Drain Piping and Tubing:

1. Install a union in piping at each threaded unit connection.
2. Install an adjustable stainless steel hose clamp with adjustable gear operator on unit hose connections. Tighten clamp to provide a leak-free installation.
3. If required for unit installation, provide a trap assembly in drain piping to prevent air circulated through unit from passing through drain piping. Comply with more stringent of the following:

    a. Details indicated on Drawings.
    b. Manufacturer's requirements.
    c. Governing codes.
    d. In the absence of requirements, comply with requirements in ASHRAE handbooks.

4. Extend drain piping from units with drain connections to drain receptors as indicated on Drawings. If not indicated on Drawings, terminate drain connection at nearest accessible location that is not exposed to view by occupants.
5. Provide each 90-degree change in direction with a Y- or T-fitting. Install a threaded plug connection in the dormant side of fitting or future use as a service cleanout.

B. Gravity Drains:

1. Slope piping from unit connection toward drain termination at a constant slope of not less than one percent.

C. Pumped Drains:

1. If unit condensate pump or lift mechanism is not included with an integral check valve, install a full-size check valve in each branch pipe near unit connection to prevent backflow into unit.

3.5 INSTALLATION OF SYSTEM HYDRONIC PIPING

A. Comply with requirements for hydronic pipe and tubing specified in Section 232113 "Hydronic Piping."

B. Comply with requirements for hydronic specialties specified in Section 232116 "Hydronic Piping Specialties."

C. Comply with requirements for ball valves specified in Section 230523 "General-Duty Valves for HVAC Piping."

D. Comply with requirements for butterfly valves specified in Section 230523 "General-Duty Valves for HVAC Piping."

E. Comply with requirements for check valves specified in Section 230523 "General-Duty Valves for HVAC Piping."

F. Install continuous-thread hanger rods and elastomeric hangers of size required to support equipment weight.

1. Comply with requirements for vibration isolation devices specified in Section 230548.13 "Vibration Controls for HVAC." Fabricate brackets or supports as required.
2. Comply with requirements for hangers and supports specified in Section 230529 "Hangers and Supports for HVAC Piping and Equipment."

G. Where installing piping and tubing adjacent to equipment, allow space for service and maintenance.

3.6 INSTALLATION OF SYSTEM REFRIGERANT PIPING

A. Refrigerant Tubing Kits:

1. Unroll and straighten tubing to suit installation. Deviations in straightness of exposed tubing are to be unnoticeable to observer.
2. Support tubing using hangers and supports indicated at intervals not to exceed 5 ft.. Minimum rod size, **1/4 inch**.
3. Prepare tubing ends and make mating connections to provide a pressure-tight and leak-free installation.

B. Install refrigerant piping in accordance with ASHRAE 15 and governing codes.

C. Select system components with pressure rating equal to or greater than system operating pressure.

D. Install piping as short and direct as possible, with a minimum number of joints and fittings.

E. Arrange piping to allow inspection and service of equipment. Install valves and specialties in accessible locations to allow for service and inspection. Install access doors or panels as specified in Section 083113 "Access Doors and Frames" if valves or

equipment requiring maintenance are concealed behind finished surfaces.

F. Install refrigerant piping and tubing in protective conduit where installed belowground.

G. Install refrigerant piping and tubing in rigid or flexible conduit in locations where exposed to mechanical damage.

H. Unless otherwise required by VRF HVAC system manufacturer, slope refrigerant piping and tubing as follows:

1. Install horizontal hot-gas discharge piping and tubing with a uniform slope downward away from compressor.
2. Install horizontal suction lines with a uniform slope downward to compressor.
3. Install traps to entrain oil in vertical runs.
4. Liquid lines may be installed level.

I. When brazing, remove or protect components that could be damaged by heat.

J. Before installation, clean piping, tubing, and fittings to cleanliness level required by VRF HVAC system manufacturer.

K. Joint Construction:

1. Ream ends of tubes and remove burrs.
2. Remove scale, slag, dirt, and debris from inside and outside of tube and fittings before assembly.
3. Construct joints in accordance with AWS's "Brazing Handbook," "Pipe and Tube" Chapter.

    a. Use Type BCuP (copper-phosphorus) alloy for joining copper fittings with copper tubing.
    b. Use Type BAg (cadmium-free silver) alloy for joining copper with bronze.

3.7 INSTALLATION OF METAL HANGERS AND SUPPORTS

A. Comply with requirements in Section 230548 "Vibration and Seismic Controls for HVAC" for seismic restraints.

B. Metal Pipe-Hanger Installation: Comply with MSS SP-58. Install hangers, supports, clamps, and attachments as required to properly support piping from the building structure.

C. Install hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.

D. Install hangers and supports to allow controlled thermal and seismic movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.

E. Install lateral bracing with pipe hangers and supports to prevent swaying.

F. Install building attachments within concrete slabs or attach to structural steel.

1. Install concrete inserts before concrete is placed; fasten inserts to forms and install reinforcing bars through openings at top of inserts.

G. Load Distribution: Install hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.

H. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and to not exceed maximum pipe deflections allowed by ASME B31.9 for building services piping.

I. Piping and Tubing Insulation:

1. Install MSS SP-58, Type 40, protective shields on cold piping with vapor barrier. Shields are to span an arc of 180 degrees.
2. Shield Dimensions for Pipe: Not less than the following: NPS 1/4 to NPS 3-1/2 (DN 8 to DN 90): **12 inches** long and **0.048 inch** thick.

J. Horizontal-Piping Hangers and Supports: Install the following types:

1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of noninsulated or insulated, stationary pipes **NPS 1/2 to NPS 30**.
2. Pipe Hangers (MSS Type 5): For suspension of pipes **NPS 1/2 to NPS 4**, to allow off-center closure for hanger installation before pipe erection.
3. Clips (MSS Type 26): For support of insulated pipes not subject to expansion or contraction.
4. Multiple horizontal pipes located indoors may use metal framing systems with split clamp attachment for each pipe in lieu of individual clevis hangers.
5. Pipe stands for horizontal pipes located outdoors.
6. Provide copper-clad hangers and supports for hangers and supports in direct contact with copper pipe.
7. On plastic pipe, install pads or cushions on bearing surfaces to prevent hanger from scratching pipe.

K. Horizontal Piping Hanger Spacing and Rod Size: Install hangers for drawn-temper copper piping with the following maximum horizontal spacing and minimum rod sizes:

1. Sizes through NPS 3/4 (DN 20): Maximum span, **5 ft.**; minimum rod size, **1/4 inch**.
2. NPS 1 (DN 25): Maximum span, **6 ft.**; minimum rod size, **1/4 inch**.
3. NPS 1-1/4 (DN 32): Maximum span, **7 ft.**; minimum rod size, **3/8 inch**.
4. NPS 1-1/2 (DN 40): Maximum span, **8 ft.**; minimum rod size, **3/8 inch**.
5. NPS 2 (DN 50): Maximum span, **8 ft.**; minimum rod size, **3/8 inch**.
6. NPS 2-1/2 (DN 65): Maximum span, **9 ft.**; minimum rod size, **3/8 inch**.
7. NPS 3 (DN 80) and Larger: Maximum span, **10 ft.**; minimum rod size, **3/8 inch**.

L. Plastic Pipe Hanger and Support Spacing:

1. Space hangers and supports in accordance with pipe manufacturer's written instructions for service conditions.
2. Maximum spacing, **5 ft.**; minimum rod size, **1/4 inch**.

M. Vertical-Piping Clamps: Install the following types:

1. Extension Pipe or Riser Clamps (MSS Type 8).
2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): If longer ends are required for riser clamps.

N. Support vertical runs at roof, at each floor, and at midpoint intervals between floors, not to exceed 5 ft..

O. Comply with MSS SP-58 for pipe-hanger selections and applications that are not specified.

P. Use hangers, supports, and attachments with galvanized coatings unless otherwise indicated.

Q. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.

R. Trim excess length of continuous-thread hanger and support rods to 1 inch.

S. Hanger-Rod Attachments: Install the following types:

1. Steel Turnbuckles (MSS Type 13): For adjustment up to **6 inches** for heavy loads.
2. Steel Clevises (MSS Type 14): For **120 to 450 deg F** piping installations.
3. Malleable-Iron Sockets (MSS Type 16): For attaching hanger rods to various types of building attachments.
4. Steel Weldless Eye Nuts (MSS Type 17): For **120 to 450 deg F** piping installations.

T. Building Attachments: Install the following types:

1. Steel or Malleable Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete ceiling.
2. Top-Beam C-Clamps (MSS Type 19): For use under roof installations with bar-joist construction, to attach to top flange of structural shape.
3. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles.
4. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.
5. Welded Beam Attachments (MSS Type 22): For attaching to bottom of beams if loads are considerable and rod sizes are large.
6. C-Clamps (MSS Type 23): For structural shapes.
7. Top-Beam Clamps (MSS Type 25): For top of beams if hanger rod is required tangent to flange edge.
8. Side-Beam Clamps (MSS Type 27): For bottom of steel I-beams.
9. Steel-Beam Clamps with Eye Nuts (MSS Type 28): For attaching to bottom of steel I-beams for heavy loads.
10. Linked-Steel Clamps with Eye Nuts (MSS Type 29): For attaching to bottom of steel I-beams for heavy loads, with link extensions.
11. Malleable-Beam Clamps with Extension Pieces (MSS Type 30): For attaching to

structural steel.

12. Welded-Steel Brackets: For support of pipes from below or for suspending from above by using clip and rod. Use one of the following for indicated loads:

    a. Light (MSS Type 31): **750 lb**.
    b. Medium (MSS Type 32): **1500 lb**.

13. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.
14. Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is required.
15. Horizontal Travelers (MSS Type 58): For supporting piping systems subject to linear horizontal movement where headroom is limited.

3.8 INSTALLATION OF FASTENER SYSTEMS

A. Fastener System Installation:

1. Install powder-actuated fasteners, for use in lightweight concrete or concrete slabs less than **4 inches** thick, in concrete after concrete is placed and completely cured. Use operators that are licensed by powder-actuated tool manufacturer. Install fasteners in accordance with powder-actuated tool manufacturer's operating manual.
2. Install mechanical-expansion anchors in concrete after concrete is placed and completely cured. Install fasteners in accordance with manufacturer's written instructions.
3. Use powder-actuated fasteners or mechanical-expansion anchors instead of building attachments where required in concrete construction.

3.9 INSTALLATION OF PIPING AND TUBING INSULATION

A. Seal longitudinal seams and end joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated. Installation to maintain a continuous vapor barrier.

B. Insulation Installation on Pipe Fittings and Elbows:

1. Install mitered sections of pipe insulation.
2. Secure insulation materials and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

C. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed valve covers manufactured of same material as pipe insulation when available.
2. When preformed valve covers are unavailable, install cut sections of pipe and sheet insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
3. Secure insulation to valves and specialties and seal seams with manufacturer's

recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

D. Where PVC jackets are indicated, install with **1-inch** overlap at longitudinal seams and end joints; for horizontal applications. Seal with manufacturer's recommended adhesive.

1. Apply two continuous beads of adhesive to seams and joints, one bead under lap and the finish bead along seam and joint edge.

E. Where metal jackets are indicated, install with **2-inch** overlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal end joints with weatherproof sealant recommended in writing by insulation manufacturer. Secure jacket with stainless steel bands **12 inches** o.c. and at end joints.

3.10 INSTALLATION OF SOFTWARE

A. Cybersecurity:

1. Software:

a. Coordinate security requirements with IT department.
b. Ensure that latest stable software release is installed and properly operating.
c. Disable or change default passwords to password using a combination of uppercase and lower letters, numbers, and symbols at least eight characters in length. Record passwords and turn over to party responsible for system operation and administration.

2. Hardware:

a. Coordinate location and access requirements with IT department.
b. Enable highest level of wireless encryption that is compatible with Owner's ICT network.
c. Disable dual network connections.

3.11 INSTALLATION OF SYSTEM CONTROL CABLE

A. Comply with NECA 1.

B. Installation Method:

1. Install cables in raceways except as follows:

a. Within equipment and associated control enclosures.
b. In accessible ceiling spaces where open cable installation method may be used.
c. In gypsum board partitions where cable may be enclosed within wall cavity.

2. Conceal raceway and cables except in unfinished spaces.

C. General Requirements for Cabling:

1. Comply with TIA-568.2-D.
2. Comply with BICSI ITSIMM, Ch. 5, "Copper Structured Cabling Systems."
3. Terminate all conductors; no cable is to contain unterminated elements. Make terminations only at indicated outlets, terminals, and cross-connect and patch panels.
4. Cables must be continuous from terminal to terminal. Do not splice cable.
5. Cables serving a common system may be grouped in a common raceway. Install control cable in separate raceway from power wiring. Do not group conductors from different systems or different voltages.
6. Secure and support cables at intervals not exceeding **30 inches** and not more than **6 inches** from cabinets, boxes, fittings, outlets, racks, frames, and terminals.
7. Bundle, lace, and train conductors to terminal points without exceeding manufacturer's limitations on bending radii, but not less than radii specified in BICSI ITSIMM, Ch. 5, "Copper Structured Cabling Systems." Install lacing bars and distribution spools.
8. Do not install bruised, kinked, scored, deformed, or abraded cable. Remove and discard cable if damaged during installation and replace it with new cable.
9. Cold-Weather Installation: Bring cable to room temperature before dereeling. Do not use heat lamps for heating.
10. Pulling Cable: Comply with BICSI ITSIMM, Ch. 5, "Copper Structured Cabling Systems." Monitor cable pull tensions.
11. Support: Do not allow cables to lie on removable ceiling tiles or access panels.
12. Secure: Fasten securely in place with hardware specifically designed and installed so as to not damage cables.
13. Provide strain relief.
14. Keep runs short. Allow extra length for connecting to terminals.
15. Do not bend cables in a radius less than 10 times the cable OD.
16. Use sleeves or grommets to protect cables from vibration at points where they pass around sharp corners and through penetrations.
17. Ground wire is to be copper, and grounding methods shall comply with IEEE C2. Demonstrate ground resistance.

D. Balanced Twisted-Pair Cable Installation:

1. Comply with TIA-568.2-D.
2. Do not untwist balanced twisted-pair cables more than **1/2 inch** at the point of termination to maintain cable geometry.

E. Open-Cable Installation:

1. Suspend copper cable not in a wireway or pathway a minimum of **8 inches** above ceilings by cable supports not more than 30 inches apart.
2. Do not route cable through or on structural members or in contact with pipes, ducts, or other potentially damaging items. Do not run cables between structural members and corrugated panels.

F. Separation from EMI Sources: Comply with BICSI TDMM and TIA-569-E recommendations for separating unshielded cable from potential EMI sources including

electrical power wiring and equipment.

3.12 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage VRF HVAC system manufacturer's service representative to advise and assist installers; witness testing; and observe and inspect components, assemblies, and equipment installations, including controls and connections.

1. Field service must be performed by an employee or a factory-trained and -authorized service representative of VRF HVAC system manufacturer whose primary job responsibilities are to provide direct technical support of its products.

    a. Additional factory-authorized representatives may assist with completion of certain activities only if supervised by manufacturer's employee. A factory-authorized representative must not provide assistance without manufacturer's employee supervision.

2. Manufacturer is to provide on-site visits during the course of construction at installation milestones indicated. System Installer is to coordinate each visit in advance to give manufacturer sufficient notice to plan the visit.

    a. First Visit: Kick-off meeting.
    b. Second Visit: At approximately 25 percent completion of system(s).
    c. Third Visit: At approximately 50 percent completion of system(s).
    d. Fourth Visit: At approximately 75 percent completion of system(s).
    e. Fifth Visit: Final inspection before system startup.

3. Kick-off Meeting:

    a. Meeting is to include system Installer and other related trades with sole purpose of reviewing VRF HVAC system installation requirements and close coordination required to make a successful installation.
    b. Meeting is to be held at Project site and scheduled at a mutually agreed to time that occurs before the start of any part of system installation.
    c. Meeting is to cover the following as a minimum requirement:

        1) Review of latest issue of Contract Documents, Drawings, and Specifications, relevant to VRF HVAC systems.
        2) Manufacturer's installation requirements specific to systems being installed.
        3) Review of all relevant VRF HVAC system submittals, including delegated design submittals.
        4) Required field activities related installation of VRF HVAC system.
        5) Project team communication protocol, contact information, and exchange of responsibilities for each party involved, including manufacturer, supplier, system Installer, and other related trades.

4. Site Visits: Activities for each site visit are to include the following:

a. Meet with VRF HVAC system Installer to discuss field activities, issues, and suggested methods to result in a successful installation.
b. Offer technical support to Installer and related trades as related to VRF system(s) being installed.
c. Review progress of VRF HVAC system(s) installation for strict compliance with manufacturer's requirements.
d. Advise and if necessary assist Installer with updating related refrigerant calculations and system documentation.
e. Issue a report for each visit, documenting the visit.

1) Report to include name and contact information of individual making the visit.
2) Date(s) and time frames while on-site.
3) Names and contact information of people meeting with while on-site.
4) Clearly identify and list each separate issue that requires resolution. For each issue, provide a unique identification number, relevant importance, specific location or equipment identification, description of issue, recommended corrective action, and follow-up requirements needed. Include a digital photo for clarification if deemed to be beneficial.

5. Final Inspection before Startup:

a. Before inspection, Installer to provide written request to manufacturer stating the system is fully installed in accordance with manufacturer's requirements and ready for final inspection.
b. All system equipment and operating components are to be inspected. If components are inaccessible for inspection, they are to be made accessible before the final inspection can be completed.
c. Manufacturer is to provide a comprehensive inspection of all equipment and each operating component that comprise the complete system(s). Inspection is to follow a detailed checklist specific to each equipment and operating component.
d. Inspection reports for indoor units are to include, but not be limited to, the following:

1) Unit designation on Drawings.
2) Manufacturer model number.
3) Serial number.
4) Network address, if applicable.
5) Each equipment setting.
6) Mounting, supports, and restraints properly installed.
7) Proper service clearance provided.
8) Wiring and power connections correct.
9) Line-voltage reading(s) within acceptable range.
10) Wiring and controls connections correct.
11) Low-voltage reading(s) within an acceptable range.
12) Controller type and model controlling unit.
13) Controller location.
14) Temperature settings and readings within an acceptable range.
15) Humidity settings and readings within an acceptable range.

16) Condensate removal acceptable.
17) Fan settings and readings within an acceptable range.
18) Unit airflow direction within an acceptable range.
19) If applicable, fan external static pressure setting.
20) Filter type and condition acceptable.
21) Noise level within an acceptable range.
22) Refrigerant piping properly connected and insulated.
23) Condensate drain piping properly connected and insulated.
24) If applicable, ductwork properly connected.
25) If applicable, external interlocks properly connected.
26) Remarks.

e. Inspection reports for outdoor units are to include, but not be limited to, the following:

1) Unit designation on Drawings.
2) Manufacturer model number.
3) Serial number.
4) Network address, if applicable.
5) Each equipment setting.
6) Mounting, supports, and restraints properly installed.
7) Proper service clearance provided.
8) Wiring and power connections correct.
9) Line-voltage reading(s) within acceptable range.
10) Wiring and controls connections correct.
11) Low-voltage reading(s) within an acceptable range.
12) Condensate removal acceptable.
13) Noise level within an acceptable range.
14) Refrigerant piping properly connected and insulated.
15) Condensate drain piping properly connected and insulated.
16) Remarks.

f. Inspection reports for indoor, dedicated outdoor air ventilation units are to include, but not be limited to, the following:

1) Unit designation on Drawings.
2) Manufacturer model number.
3) Serial number.
4) Network address, if applicable.
5) Each equipment setting.
6) Mounting, supports, and restraints properly installed.
7) Proper service clearance provided.
8) Wiring and power connections correct.
9) Line-voltage reading(s) within acceptable range.
10) Wiring and controls connections correct.
11) Low-voltage reading(s) within an acceptable range.
12) Controller type and model controlling unit.
13) Controller location.
14) Temperature settings and readings within an acceptable range.
15) Humidity settings and readings within an acceptable range.
16) Condensate removal acceptable.

17) Fan settings and readings within an acceptable range.
18) Fan external static pressure setting.
19) Filter type and condition acceptable.
20) Noise level within an acceptable range.
21) Refrigerant piping properly connected and insulated.
22) Condensate drain piping properly connected and insulated.
23) Automatic dampers properly installed and operating.
24) Ductwork properly connected.
25) If applicable, external interlocks properly connected.
26) Remarks.

g. Inspection reports for energy recovery ventilators are to include, but not be limited to, the following:

1) Unit designation on Drawings.
2) Manufacturer model number.
3) Serial number.
4) Network address, if applicable.
5) Each equipment setting.
6) Mounting, supports, and restraints properly installed.
7) Proper service clearance provided.
8) Wiring and power connections correct.
9) Line-voltage reading(s) within acceptable range.
10) Wiring and controls connections correct.
11) Low-voltage reading(s) within an acceptable range.
12) Controller type and model controlling unit.
13) Controller location.
14) Temperature settings and readings within an acceptable range.
15) Humidity readings.
16) Condensate removal acceptable.
17) Fan settings and readings within an acceptable range.
18) Fan external static pressure setting.
19) Filter type and condition acceptable.
20) Noise level within an acceptable range.
21) Automatic dampers properly installed and operating.
22) Ductwork properly connected.
23) If applicable, external interlocks properly connected.
24) Remarks.

h. Inspection reports for hydronic units are to include, but not be limited to, the following:

1) Unit designation on Drawings.
2) Manufacturer model number.
3) Serial number.
4) Network address, if applicable.
5) Each equipment setting.
6) Mounting, supports, and restraints properly installed.
7) Proper service clearance provided.
8) Wiring and power connections correct.
9) Line-voltage reading(s) within acceptable range.

10) Wiring and controls connections correct.
11) Low-voltage reading(s) within an acceptable range.
12) Controller type and model controlling unit.
13) Controller location.
14) Temperature settings and readings within an acceptable range.
15) Condensate removal acceptable.
16) Noise level within an acceptable range.
17) Refrigerant piping properly connected and insulated.
18) Hydronic piping properly connected and insulated.
19) Proof of water flow checked for proper operation.
20) Condensate drain piping properly connected and insulated.
21) If applicable, external interlocks properly connected.
22) Remarks.

i. Installer is to provide manufacturer with the requested documentation and technical support during inspection.
j. Installer is to correct observed deficiencies found by the inspection.
k. Upon completing the on-site inspection, manufacturer is to provide a written report with complete documentation describing each inspection step, the result, and any corrective action required.
l. If corrective action is required by Installer that cannot be completed during the same visit, provide additional visits, as required, until deficiencies are resolved and systems are deemed ready for startup.
m. Final report is to indicate the system(s) inspected are installed in accordance with manufacturer's requirements and are ready for startup.

B. Perform tests and inspections with the assistance of manufacturer's service representative as follows:

1. Perform each visual and mechanical inspection and electrical test stated in NETA ATS. Certify compliance with test parameters.
2. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
3. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

C. Refrigerant Tubing Positive Pressure Testing:

1. Comply with more stringent of VRF HVAC system manufacturer's requirements and requirements indicated.
2. After completion of tubing installation, pressurize tubing systems to a test pressure of not less than 1.2 times VRF HVAC system operating pressure, but not less than 600 psig, using dry nitrogen.
3. Successful testing is to show test pressure is maintained for a continuous and uninterrupted period of 24 hours. Allowance for pressure changes attributed to changes in ambient temperature are acceptable.
4. Prepare test report to record information for each test as follows:

a. Name of person starting test, company name, phone number, and e-mail

address.
b. Name of manufacturer's service representative witnessing test, company name, phone number, and e-mail address.
c. Detailed description of extent of tubing tested.
d. Date and time at start of test.
e. Test pressure at start of test.
f. Outdoor temperature at start of test.
g. Name of person ending test, company name, phone number, and e-mail address.
h. Date and time at end of test.
i. Test pressure at end of test.
j. Outdoor temperature at end of test.
k. Remarks:

5. Submit test reports for Project record.

D. Refrigerant Tubing Evacuation Testing:

1. Comply with more stringent of VRF HVAC system manufacturer's requirements and requirements indicated.
2. After completion of tubing positive-pressure testing, evacuate tubing systems to a pressure of 500 microns.
3. Successful testing is to show test pressure is maintained for a continuous and uninterrupted period of one hour(s) with no change.
4. Prepare test report to record information for each test as follows:

a. Name of person starting test, company name, phone number, and e-mail address.
b. Name of manufacturer's service representative witnessing test, company name, phone number, and e-mail address.
c. Detailed description of extent of tubing tested.
d. Date and time at start of test.
e. Test pressure at start of test.
f. Outdoor temperature at start of test.
g. Name of person ending test, company name, phone number, and e-mail address.
h. Date and time at end of test.
i. Test pressure at end of test.
j. Outdoor temperature at end of test.
k. Remarks:

5. Submit test reports for Project record.
6. Upon successful completion of evacuation testing, system is to be charged with refrigerant.

E. System Refrigerant Charge:

1. Using information collected from the refrigerant tubing evacuation testing, system Installer is to consult variable refrigerant system manufacturer to determine the correct system refrigerant charge.
2. Installer is to charge system following VRF HVAC system manufacturer's written

instructions.

3. System refrigerant charging is to be witnessed by system manufacturer's representative.
4. Total refrigerant charge is to be recorded and permanently displayed at the system's outdoor unit.

F. Products will be considered defective if they do not pass tests and inspections.

G. Prepare test and inspection reports.

3.13 MAINTENANCE SERVICE

A. Beginning at Substantial Completion, verify that maintenance service includes 12 months' full maintenance bymanufacturer's authorized service representative. Include two service visits for preventive maintenance, repair or replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper equipment and system operation. Verify that parts and supplies are manufacturer's authorized replacement parts and supplies.

3.14 DEMONSTRATION

A. Engage a VRF HVAC system manufacturer's employed training instructor or factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain entire system.

B. Instructor:

1. Instructor is to be factory trained and certified by VRF HVAC system manufacturer with current training on the system(s), equipment, and controls that are installed.
2. Instructor's credentials are to be submitted for review by Architect before scheduling training.
3. Instructor(s) primary job responsibility is to be Owner training.
4. Instructor(s) is to have not less than three years of training experience with VRF HVAC system manufacturer and past training experience on at least three projects of comparable size and complexity.

C. Schedule and Duration:

1. Schedule training with Owner at least 20 business days before first training session.
2. Training is to occur before Owner occupancy.
3. Training is to be held at mutually agreed date and time during normal business hours.
4. Each training day is not to exceed eight hours of training. Daily training schedule is to allow time for one -hour lunch period and 15 -minute break after every two hours of training.
5. Perform not less than eight total hours of training.

D. Location: Owner is to provide a suitable on-site location to host classroom training.

E. Training Attendees: Estimate three people.

F. Training Attendance: For record purposes, document training attendees at the start of each new training session. Record attendee's name, signature, phone number, and e-mail address.

G. Training Format: Individual training modules are to include classroom training followed by hands-on field demonstration and training.

H. Training Materials: Provide training materials in electronic format to each attendee.

1. Include instructional videos showing general operation and maintenance that are coordinated with operation and maintenance manuals.
2. Video record each classroom training session and submit an electronic copy to Owner before requesting Owner acceptance of training.

I. Acceptance: Obtain Architect written acceptance that training is complete and requirements indicated have been satisfied.

END OF SECTION 23 81 29

IRALENA HOTEL
BID DOCUMENTS
APRIL 24, 2026

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SECTION 26 05 00 - ELECTRICAL GENERAL REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

The Electrical General Requirements are supplementing and applicable to Division 26 Sections and shall apply to all phases of work specified herein, shown on the Drawings, or required to provide a complete installation of electrical systems. Section 26 is sub-divided for convenience only.

A. This Section includes the following:

1. Job Conditions
2. Regulatory Requirements
3. Electrical equipment coordination and installation.
4. Submittals, Operating and Maintenance instructions and As-built drawings.
5. Common electrical installation requirements.
6. Warranty of work.

1.2 JOB CONDITIONS:

A. Site Inspections: Before submitting proposals, each bidder should visit the site and fully familiarize himself with all job conditions and shall be fully informed as to the extent of his work. No consideration will be given after bid opening date for alleged misunderstanding as to the requirements of work involved in connecting to the utilities or as to requirements of materials to be furnished. The contractor shall contact the utility prior to bid and make appropriate provisions in such bid as required by the utility for the utility's routing and connection.

B. Accidental Interruptions: All excavation and/or remodeling work required shall be performed with care so as not to interrupt other existing services (water, gas, electrical, sewer, sprinklers, etc.). If accidental utility interruption resulting from work performed by the Contractor occurs, service shall be immediately restored to its original condition without delay, by and at the expense of the Contractor, using skilled workmen of the trade required.

1.3 REGULATORY REQUIREMENTS:

A. Permits, Fees, and Inspections: This Contractor shall secure and pay for all permits, and inspections required on work performed under this section of the Specifications. He shall assume full responsibility for all assessments and taxes necessary for the completion and acceptance of the work.

B. Applicable Standards and Codes: The electrical installation shall comply with all applicable building codes; local, state, and federal ordinances. In case of a discrepancy among these applicable regulatory codes and ordinances, the most stringent requirement shall govern. The Contractor shall notify the Architect in writing of any such discrepancy. Should the Contractor perform any work that does not comply with the applicable regulatory codes and ordinances he shall bear all cost arising in correcting the deficiencies. Application standards and codes shall include all local ordinances, all state laws, and the applicable requirements of the following:

1. American National Standards Institute - ANSI
2. National Electrical Manufacturer's Association - NEMA
3. National Fire Protection Association – NFPA (latest editions)
4. The National Electric Code – NEC – NFPA 70, 2023
5. The Life Safety Code – NFPA 101, 2024
6. The National Fire Alarm Code – NFPA 72, 2025
7. Florida Building Code, 2023 Edition
8. Underwriters' Laboratories, Inc. – UL

C. Drawings and Specifications: The drawings and these specifications are complementary each to the other. What is called for by one shall be as binding as if called for by both. Omissions from the drawings and specifications of details of work which are evidently necessary to carry out the intent of the drawings and specifications, or which are customarily performed, shall not relieve the Contractor from performing such work. In any case of discrepancy in the figures or catalog numbers, the matter shall be submitted to the Architect, who shall promptly make a determination in writing. Any adjustment by the Contractor shall be at the Contractor's own risk and expense. Electrical drawings are diagrammatic only. Do not scale these drawings. All equipment shall be installed in accordance with manufacturer's recommendations and any conflicting data shall be verified before bidding.

D. The Contractor shall after completion of the work, furnish the Architect a certificate of final inspection and approval from the applicable local inspection department. The Contractor shall also make necessary changes to plans and specifications to meet code standards at no additional cost to the Owner.

1.4 CONNECTION TO EXISTING UTILITIES:

A. All utility work shall be coordinated with and approved by the local providing utility. Permission for all utility outages shall be requested a minimum of (10) days in advance unless an emergency arises. Explicit detail shall be shown for all connections to existing utilities. The applicable utility company must approve both the location and the method of the proposed connection.

B. The contractor shall coordinate procedure to, and shall pay for, all electric energy consumption during construction as part of the project.

C. The contractor shall include the electric utility connection fee in the bid unless specifically directed by Owner not to do so. If, prior to bid, the electric utility connection fee is unknown, the Contractor shall include $25,000 as a line item in the bid for each service. Once the utility connection fee is known, if the utility connection fee is less than $25,000, the balance shall be removed from the Contractor's total contract price.

1.5 COOPERATION:

A. Interfacing with Other Crafts: It shall be the responsibility of the Contractor to cooperate and coordinate with all other crafts working on this project. This Contractor shall do all cutting, trenching, backfill and structural removals to permit entry of the electrical system components. The General Contractor shall do all patching and finishing.

B. Equipment Furnished Under Other Sections: This Contractor shall furnish and install, complete electrical roughing-in and connections to all equipment furnished under other sections and indicate on drawings. This includes all outlets as shown on mechanical and electrical drawings. All such equipment shall be set in place as work of other sections.

C. Heating and Air Conditioning:

1. The Contractor shall furnish all branch circuit wiring to motors and control panels or centers including disconnects, receptacles, switches, and appurtenances to which the system at the units may be connected, to provide a complete system of wiring for power. Control equipment and control circuit wiring is specified in the Mechanical Section.

2. Control devices to be included in the branch circuit, except those furnished integrals with the equipment, will be delivered by the Heating and Air Conditioning Contractor and installed by the Electrical Contractor.

1.6 WORKMANSHIP:

A. All work shall be executed in a neat and substantial manner by skilled workman, well qualified, and regularly engaged in the type of work required. Substandard work shall be removed and replaced by the Contractor at no cost to the Owner.

B. Contractor shall notify architect for inspection at the following milestones:
   1. Below Slab - before slab pour.
   2. In-Wall - before wall coverings are to be installed.
   3. Above Ceiling - before ceiling finishes / coverings are to be installed.
   4. Substantial Completion - for final punch list items and noted deficiencies.
   5. Final Inspection - for completion of punch list items.

1.7 APPROVAL OF MATERIALS AND EQUIPMENT:

Prior-Submittals: The Contractor shall base his proposal on the materials specified herein and on the drawings. Reference to a particular product by manufacturer, trade name, or catalog number establishes the quality standards of material and equipment required for this installation and is not intended to exclude products equal in quality and similar design. The Specifying Engineer reserves the sole right to decide the equality of materials proposed for use in lieu of these specified. It shall be the Contractor's responsibility to furnish the information and data sufficient to establish the quality and utility of the items in question, including furnishing of samples if required. If other equipment manufacturers determine that their equipment will fit in the space and meet the recommended clearances, suit all job conditions, equal or exceed the quality of the specified items, then a request may be made in writing to the Specifying Engineer at least ten (10) business days prior to bid date for permission to be included in the approved equipment list. All data required for evaluation shall accompany the above letter. The Specifying Engineer offers two submittal reviews, if these are unacceptable, only an “as-specified” submittal will be accepted. In addition, all value engineering alternates should only be submitted when directly requested by the owner and must be noted specifically as “VE” alternates to the items specified in the construction documents. A letter from the owner directing the VE effort is strongly encouraged as an accompaniment to any VE submittal.

A. Submittals:

1. Submittals: The Contractor shall submit a list of equipment proposed for installation. Catalog data and shop drawings on all proposed systems and their components shall be submitted. Where substitutions alter the design or space requirements, the Contractor shall defray all items of cost for the revised design and construction including costs to all allied trades involved. Provide six (6) copies of submittals and shop drawings as a minimum unless the General Conditions requires a greater number of copies. In lieu of paper copies, the Contractor may submit the submittals in PDF format.

a. Submittals Schedule: Submittals shall be submitted within thirty (30) days after the contract is awarded. It is not the responsibility of the Engineer to expedite the review of submittals if the contractor has not adequately prepared the submittals in a time efficient manner. The contractor bears all the responsibility for the added time requirements of resubmittals.

b. Identification: Place a permanent label or title block on each submittal for identification. Each major section of submittals such as power equipment, lighting equipment, fire alarm, etc., shall be secured together in a booklet or stapled with a covering index. The different parts of the submittal shall describe which Specification Section it is referenced. The covering index shall list the following information:
   1) Project name and date
   2) Name, address, and phone number of General contractor and project manager.
   3) Name, address, and phone number of Sub-contractor and project manager.
   4) Supplier of equipment with phone number and person responsible for this project.
   5) Index of each item covered in submittal and model number.
   6) Any deviation from contract documents shall be specifically noted on submittal cover index and specifically identified with highlighting, encircling, or boldly on specific submittal sheet.

c. The submittal shall not be in individual parts per each Specification Section but be combined as a part of a major section such as power equipment, lighting equipment, fire alarm, methods, etc.

d. Resubmittals: The Specifying Engineer will participate in two resubmittal reviews. After the second resubmittal review, the Engineer shall not review the submittal until the Contractor provides $1,000 to the Engineer to perform each additional required resubmittal review. Make resubmittals in same form and number of copies as initial submittal.
   1) Include previous submittal review comments.
   2) For each item being resubmitted, include previous review comment and explain how resubmitted item meets the criteria of the previous review comment.

2. Electrical and Mechanical/Plumbing/Fire Protection Equipment Coordination:

The electrical power equipment submittals shall be accompanied by a letter verifying coordination of electrical services for all mechanical, plumbing, and fire protection equipment requiring power. The letter shall follow the format listed below.

To: _____
(General Contractor)

Re: _____
(Project name and location)

We the undersigned subcontractors certify that we have coordinated the electrical requirements for mechanical, plumbing, and fire protection sprinkler equipment as evidenced by the coordination chart listed herein.

Item	Load Full Load Amps	1 Phase or 3 Phase	Number of Electrical Connections	Maximum Overcurrent Protection	Minimum Overcurrent Protection	Breaker Proposed	Circuit Proposed

The above list details all required electrical connections for mechanical equipment.

Signed: _____

For: _____
Mechanical Subcontractor

The above list details all required electrical connections for plumbing equipment.

Signed: _____

For: _____
Plumbing Subcontractor

The above list details all required electrical and fire alarm connections for fire protection equipment.

Signed: _____

For: _____
Fire Protection Sprinkler Subcontractor

The above list of equipment has been reviewed and the required connections are being provided. (Any exceptions or request for direction shall be listed here)

Signed: _____

For: _____
Electrical Subcontractor

1.8 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Protection: Take necessary precautions to protect all material, equipment, apparatus, and work from damage. Failure to do so to the satisfaction of the Architect will be sufficient cause for the rejection of the material, equipment, or work in question. Contractor is responsible for the safety and good condition of the materials installed until final acceptance by the owner.

B. Cleaning: Conduit openings shall be capped or plugged during installation. Fixtures and equipment shall be tightly covered and protected against dirt, moisture, chemical and mechanical injury. At the completion of the work the fixtures, material and equipment shall be thoroughly cleaned and delivered in condition satisfactory to the Architect.

1.9 TESTING AND BALANCING:

Make tests that may be required by the Owner or the Architect in connection with the operation of the electrical system in the buildings. Verify phase rotation of electrical system and that voltages are within acceptable limits. Balance all single-phase loads connected to all panelboards in the buildings to insure approximate equal divisions of these loads on the main secondary power supply serving the

buildings. All tests shall be made in accordance with the latest standards of the IEEE and the NEC. The installation shall be tested as defined in the 26 specifications. Contractor shall perform circuit continuity and operational tests on all equipment furnished or connected by Contractor. The tests shall be made in the presence of the Architect or his representative. The Contractor shall notify the Architect at least twenty-four (24) hours in advance of tests. The Contractor shall provide all testing equipment and all costs shall be borne by him. Written reports shall be made of all tests and shall be made available at the Pre-Final Inspection**.** All faults shall be corrected immediately.

A. A letter shall be written giving the following:

1. Measured amps on each phase of each panel.
2. Resistance to ground of each new grounding electrode.
3. Measured voltage phase to phase and phase to neutral at each panel.
4. Ground continuity and polarity instrument used.

1.10 OPERATING AND MAINTENANCE INSTRUCTIONS/AS BUILT DRAWINGS:

A. Four (4) complete sets of instructions containing the manufacturer's Operating and Maintenance (O&M) instructions for each piece of equipment shall be furnished to the Owner. Each set shall be permanently bound and shall have a hard cover. One complete set shall be furnished at the time that the test procedure is submitted, and remaining sets shall be furnished before the Contract is completed. Flysheets shall be placed before instructions covering each subject. The instruction sheets shall be approximately 8-1/2" by 11" with large sheets of Drawings folded in. The instructions shall include information for major pieces of equipment and systems. In addition, a CD shall be provided to the Owner with the O&M Manuals and Drawings contained therein.

B. This Contractor shall provide as-built Drawings at the completion of the job. Drawings shall show all significant changes in equipment, wiring, routing, location, etc. All underground conduit routing shall be accurately indicated with locations dimensioned. As-built drawings shall be submitted for review as red-lined on a field hard copy (digitally edited PDF documents are also acceptable).

C. All signals, communications, data, control, dimming systems, etc. shall be included in the As-Built drawings. Where electrical drawings contain a large number of items that prevent easy discernment of the As-Built system, enlarged details or other graphic methods shall be used to clarify the identification required for As-Builts usage.

D. As-Built drawings shall include the following information:

1. Stub-out locations dimensioned from permanent building lines.
2. Routing of all main feeders and identified as under slab, in slab, above ceiling, etc. also for lighting and power branch circuits the number of conductors shall be included, and for feeders and motor branch circuits the number, size, and insulation of conductors shall be included.
3. Corrected panel board and equipment schedules.
4. Corrected circuit numbers as they appear on the panel board directories.
5. Corrected motor horsepower and full load amperes.
6. Location of major distribution open junction boxes with 2" conduit and over.
7. Location of all underground raceways or duct banks dimensioned from easily identified points with depth indicated from BFG (below finished grade) and by elevation in feet.

1.11 GUARANTEE AND SERVICE:

A. Upon completion of all tests and acceptance, the Contractor shall furnish the Owner a written guarantee covering the electrical work done for a period of one (1) year from date of acceptance. Guarantee

includes equipment capacity and performance ratings specified without excessive noise levels. Upon notice from the Architect or the Owner, the Contractor shall, during the guarantee period, rectify and replace any defective material or workmanship and repair any damage caused thereby without additional cost.

PART 2 - EXECUTION

2.1 COMMON REQUIREMENTS FOR ELECTRICAL INSTALLATION

A. Comply with NECA 1-2015.

B. Measure indicated mounting heights to bottom of unit for suspended items and to center of unit for wall-mounting items.

C. Headroom Maintenance: If mounting heights or other location criteria are not indicated, arrange and install components and equipment to provide maximum possible headroom consistent with these requirements.

D. Equipment: Install to facilitate service, maintenance, and repair or replacement of components of both electrical equipment and other nearby installations. Connect in such a way as to facilitate future disconnecting with minimum interference with other items in the vicinity.

E. Right of Way: Give to raceways and piping systems installed at a required slope.

END OF SECTION 26 05 00

SECTION 26 05 19 - LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Copper building wire rated 600 V or less.
2. Aluminum building wire rated 600 V or less.
3. Metal-clad cable, Type MC, rated 600 V or less.
4. Fire-alarm wire and cable.
5. Connectors, splices, and terminations rated 600 V and less.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Product Schedule: Indicate type, use, location, and termination locations.

1.3 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

PART 2 - PRODUCTS

2.1 COPPER BUILDING WIRE

A. Description: Flexible, insulated, and uninsulated, drawn copper current-carrying conductor with an overall insulation layer or jacket, or both, rated 600 V or less.

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Alpha Wire Company.
2. General Cable Technologies Corporation.
3. Okonite Company (The).
4. Southwire Company.

C. Standards:

1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.
2. RoHS compliant.

3. Conductor and Cable Marking: Comply with wire and cable marking according to UL's "Wire and Cable Marking and Application Guide."

D. Conductors: Copper, complying with ASTM B3 for bare annealed copper and with ASTM B8 for stranded conductors.

1. Type NM: Comply with UL 83 and UL 719. (Romex – inside Dwelling Units Only)
2. Type RHH and Type RHW-2: Comply with UL 44.
3. Type USE-2 and Type SE: Comply with UL 854.
4. Type THHN and Type THWN-2: Comply with UL 83.
5. Type THW and Type THW-2: Comply with NEMA WC-70/ICEA S-95-658 and UL 83.
6. Type XHHW-2: Comply with UL 44.

2.2 ALUMINUM BUILDING WIRE

A. Description: Flexible, insulated and uninsulated, drawn aluminum current-carrying conductor with an overall insulation layer or jacket, or both, rated 600 V or less.

B. Allowed Use Locations: Aluminum conductors may only be used on feeder or distribution circuits larger than 100A. The Drawings typically indicate all conductor sizes in copper. The contractor shall provide a cross reference table for engineer approval prior to any conductor to be substituted with an aluminum conductor.

C. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Alpha Wire Company.
2. General Cable Technologies Corporation.
3. Okonite Company (The).
4. Southwire Company.

D. Standards:

1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.
2. RoHS compliant.
3. Conductor and Cable Marking: Comply with wire and cable marking according to UL's "Wire and Cable Marking and Application Guide."

E. Conductors: Aluminum, complying with ASTM B800 and ASTM B801.

1. Type NM: Comply with UL 83 and UL 719. (Romex – inside Dwelling Units Only)
2. Type RHH and Type RHW-2: Comply with UL 44.
3. Type USE-2 and Type SE: Comply with UL 854.
4. Type THHN and Type THWN-2: Comply with UL 83.
5. Type THW and Type THW-2: Comply with NEMA WC-70/ICEA S-95-658 and UL 83.
6. Type XHHW-2: Comply with UL 44.

2.3 METAL-CLAD CABLE, TYPE MC

A. Description: A factory assembly of one or more current-carrying insulated conductors in an overall metallic sheath.

B. Allowed Use Locations: Metal-clad cable, Type MC shall only be used in walls from end of circuit devices (receptacles or switches) up to junction box above ceiling for homerun circuit or light fixture. Homerun circuit shall not be in Type MC cable. Wiring between devices within walls are allowed to be in Type MC cable.

C. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. General Cable Technologies Corporation.
2. Okonite Company (The).
3. Southwire Company.

D. Standards:

1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.
2. Comply with UL 1569.
3. RoHS compliant.
4. Conductor and Cable Marking: Comply with wire and cable marking according to UL's "Wire and Cable Marking and Application Guide."

E. Circuits:

1. Single circuit.

F. Conductors: Copper, complying with ASTM B3 for bare annealed copper and with ASTM B8 for stranded conductors.

G. Ground Conductor: Insulated.

H. Conductor Insulation:

1. Type TFN/THHN/THWN-2: Comply with UL 83.
2. Type XHHW-2: Comply with UL 44.

I. Armor: Steel, interlocked.

J. Jacket: PVC applied over armor.

2.4 FIRE-ALARM WIRE AND CABLE

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. General Cable Technologies Corporation.
2. Okonite Company (The).
3. Southwire Company.

B. General Wire and Cable Requirements: NRTL listed and labeled as complying with NFPA 70, Article 760.

C. Signaling Line Circuits: Twisted, shielded pair, not less than No. 16 AWG.

D. Non-Power-Limited Circuits: Solid-copper conductors with 600-V rated, 75 deg C, color-coded insulation, and complying with requirements in UL 2196 for a two-hour rating.

1. Low-Voltage Circuits: No. 16 AWG, minimum, in pathway.
2. Line-Voltage Circuits: No. 12 AWG, minimum, in pathway.

2.5 CONNECTORS AND SPLICES

A. Description: Factory-fabricated connectors, splices, and lugs of size, ampacity rating, material, type, and class for application and service indicated; listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.

B. Jacketed Cable Connectors: For steel and aluminum jacketed cables, zinc diecast with set screws, designed to connect conductors specified in this Section.

PART 3 - EXECUTION

3.1 CONDUCTOR MATERIAL APPLICATIONS

A. Feeders: Copper for feeders smaller than No. 3 AWG; copper or aluminum for feeders No. 3 AWG and larger. Conductors shall be solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.

B. Branch Circuits: Copper. Solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.

C. Power-Limited Fire Alarm and Control: Solid for No. 12 AWG and smaller.

3.2 CONDUCTOR INSULATION AND MULTICONDUCTOR CABLE APPLICATIONS AND WIRING METHODS

A. Service Entrance: Type THHN/THWN-2, single conductors in raceway.

B. Exposed Feeders: Type THHN/THWN-2, single conductors in raceway.

C. Feeders Concealed in Ceilings and Crawlspaces: Type THHN/THWN-2, single conductors in raceway.

D. Feeders Concealed in Walls and Partitions: Type THHN/THWN-2, single conductors in raceway.

E. Feeders Concealed in Concrete, below Slabs-on-Grade, and Underground: Type XHHW-2, single conductors in raceway.

F. Feeders in Cable Tray: Type THHN/THWN-2, single conductors in raceway or Type RHW-2/USE-2 if exterior located.

G. Exposed Branch Circuits, Including in Crawlspaces: Type XHHW-2, single conductors in raceway.

H. Dwelling Unit only - Branch Circuits Concealed in Ceilings, Walls, and Partitions: Nonmetallic-sheathed cable, Type NM

I. Branch Circuits Concealed in Ceilings, Walls, and Partitions: Type THHN/THWN-2, single conductors in raceway.

J. Branch Circuits Concealed in Concrete, below Slabs-on-Grade, and Underground: Type XHHW-2, single conductors in raceway.

3.3 INSTALLATION OF CONDUCTORS AND CABLES

A. Conceal cables in finished walls, ceilings, and floors unless otherwise indicated.

B. Complete raceway installation between conductor and cable termination points prior to pulling conductors and cables.

C. Use manufacturer-approved pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.

D. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips, that will not damage cables or raceway.

E. Install exposed cables parallel and perpendicular to surfaces of exposed structural members and follow surface contours where possible.

F. Support cables accordingly as required by other Specification sections."

3.4 INSTALLATION OF FIRE-ALARM WIRING

A. Comply with NECA 1 and NFPA 72.

B. Wiring within Enclosures: Separate power-limited and non-power-limited conductors as recommended by manufacturer. Install conductors parallel with or at right angles to sides and back of the enclosure. Bundle, lace, and train conductors to terminal points with no excess. Connect conductors that are terminated, spliced, or interrupted in any enclosure associated with fire-alarm system to terminal blocks. Mark each terminal according to system's wiring diagrams. Make all connections with approved crimp-on terminal spade lugs, pressure-type terminal blocks, or plug connectors.

C. Cable Taps: Use numbered terminal strips in junction, pull, and outlet boxes, cabinets, or equipment enclosures where circuit connections are made.

D. Color-Coding: Color-code fire-alarm conductors differently from the normal building power wiring. Use one color-code for alarm circuit wiring and another for supervisory circuits. Color-code audible alarm-indicating circuits differently from alarm-initiating circuits. Use different colors for visible alarm-indicating devices. Paint fire-alarm system junction boxes and covers red.

E. Wiring to Remote Alarm Transmitting Device: 1-inch conduit between the fire-alarm control panel and the transmitter. Install number of conductors and electrical supervision for connecting wiring as needed to suit monitoring function.

3.5 CONNECTIONS

A. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A-486B.

B. Make splices, terminations, and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than unspliced conductors.

1. Use oxide inhibitor in each splice, termination, and tap for aluminum conductors.

C. Wiring at Outlets: Install conductor at each outlet, with at least 12 inches of slack.

D. Prior to conduit/conductor routing to outlets, contractor shall request final verification of locations. Outlets shall be allowed to be moved 10 feet prior to installation with no cost change.

E. Comply with requirements in accompanying Section on Fire Alarm Systems for connecting, terminating, and identifying wires and cables.

3.6 IDENTIFICATION

A. Identify and color-code conductors and cables according to requirements in accompanying Sections in this book of Specifications.

B. Identify each spare conductor at each end with identity number and location of other end of conductor and identify as spare conductor.

3.7 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR ELECTRICAL PENETRATIONS

A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies. Comply with requirements in accompanying Sections in this book of Specifications.

3.8 FIRESTOPPING

A. Apply firestopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly according to requirements in accompanying Sections in this book of Specifications.

END OF SECTION 26 05 19

SECTION 26 05 26 - GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes grounding and bonding systems and equipment.

B. Section includes grounding and bonding systems and equipment, plus the following special applications:
   1. Foundation steel electrodes.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.3 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Plans showing dimensioned as-built locations of grounding features specified in "Field Quality Control" Article.

B. Field quality-control reports.

1.4 CLOSEOUT SUBMITTALS

A. Operation and maintenance data.

   1. Plans showing as-built, dimensioned locations of system described in "Field Quality Control" Article, including the following:

      a. Ground rods.

1.5 QUALITY ASSURANCE

A. Testing Agency Qualifications: Certified by NETA.

PART 2 - PRODUCTS

2.1 SYSTEM DESCRIPTION

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Comply with UL 467 for grounding and bonding materials and equipment.

2.2 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Burndy; Part of Hubbell Electrical Systems.
2. ERICO; a brand of nVent.
3. Galvan Industries, Inc.; Electrical Products Division, LLC.
4. O-Z/Gedney; a brand of Emerson Industrial Automation.
5. Thomas & Betts Corporation; A Member of the ABB Group.

2.3 CONDUCTORS

A. Insulated Conductors: Copper or tinned-copper wire or cable insulated for 600 V unless otherwise required by applicable Code or authorities having jurisdiction.

B. Bare Copper Conductors:

1. Solid Conductors: ASTM B 3.
2. Stranded Conductors: ASTM B 8.
3. Tinned Conductors: ASTM B 33.
4. Bonding Cable: 28 kcmil, 14 strands of No. 17 AWG conductor, 1/4 inch in diameter.
5. Bonding Conductor: No. 4 or No. 6 AWG, stranded conductor.
6. Bonding Jumper: Copper tape, braided conductors terminated with copper ferrules; 1-5/8 inches wide and 1/16 inch thick.
7. Tinned Bonding Jumper: Tinned-copper tape, braided conductors terminated with copper ferrules; 1-5/8 inches wide and 1/16 inch thick.

C. Grounding Bus: Predrilled rectangular bars of annealed copper, 1/4 by 4 inches in cross section, with 9/32-inch holes spaced 1-1/8 inches apart. Stand-off insulators for mounting shall comply with UL 891 for use in switchboards, 600 V and shall be Lexan or PVC, impulse tested at 5000 V.

2.4 CONNECTORS

A. Listed and labeled by an NRTL acceptable to authorities having jurisdiction for applications in which used and for specific types, sizes, and combinations of conductors and other items connected.

B. Welded Connectors: Exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installation conditions.

C. Bus-Bar Connectors: Compression type, copper or copper alloy, with two wire terminals.

D. Beam Clamps: Mechanical type, terminal, ground wire access from four directions, with dual, tin-plated or silicon bronze bolts.

E. Cable-to-Cable Connectors: Compression type, copper or copper alloy.

F. Cable Tray Ground Clamp: Mechanical type, zinc-plated malleable iron.

G. Conduit Hubs: Mechanical type, terminal with threaded hub.

D. Ground Rod Clamps: Mechanical type, copper or copper alloy, terminal with hex head bolt.

E. Lay-in Lug Connector: Mechanical type, copper rated for direct burial terminal with set screw.

F. Signal Reference Grid Clamp: Mechanical type, stamped-steel terminal with hex head screw.

G. Straps: Solid copper, copper lugs. Rated for 600 A.

H. U-Bolt Clamps: Mechanical type, copper or copper alloy, terminal listed for direct burial.

I. Water Pipe Clamps:

1. Mechanical type, two pieces with stainless-steel bolts.

a. Material: Die-cast zinc alloy.
b. Listed for direct burial.

2. U-bolt type with malleable-iron clamp and copper ground connector rated for direct burial.

2.5 GROUNDING ELECTRODES

A. Ground Rods: Copper-clad steel, sectional type; 3/4 inch by 10 feet.

B. Ground Plates: 1/4 inch thick, hot dip galvanized.

PART 3 - EXECUTION

3.1 APPLICATIONS

A. Conductors: Install solid conductor for No. 10 AWG and smaller, and stranded conductors for No. 8 AWG and larger unless otherwise indicated.

B. Grounding Bus: Install in electrical equipment rooms, in rooms housing service equipment, and elsewhere as indicated.

1. Install bus horizontally, on insulated spacers 2 inches minimum from wall, 6 inches above finished floor unless otherwise indicated.
2. Where indicated on both sides of doorways, route bus up to top of door frame, across top of doorway, and down; connect to horizontal bus.

C. Conductor Terminations and Connections:

1. Pipe and Equipment Grounding Conductor Terminations: Bolted connectors.
2. Underground Connections: Welded connectors except at test wells and as otherwise indicated.
3. Connections to Ground Rods at Test Wells: Bolted connectors.
4. Connections to Structural Steel: Welded connectors.

3.2 GROUNDING AT THE SERVICE

A. Equipment grounding conductors and grounding electrode conductors shall be connected to the ground bus. Install a main bonding jumper between the neutral and ground buses.

3.3 EQUIPMENT GROUNDING

A. Install insulated equipment grounding conductors with all feeders and branch circuits.

B. Air-Duct Equipment Circuits: Install insulated equipment grounding conductor to duct-mounted electrical devices operating at 120 V and more, including air cleaners, heaters, dampers, humidifiers, and other duct electrical equipment. Bond conductor to each unit and to air duct and connected metallic piping.

C. Water Heater, Heat-Tracing, and Anti-frost Heating Cables: Install a separate insulated equipment grounding conductor to each electric water heater and heat-tracing cable. Bond conductor to heater units, piping, connected equipment, and components.

D. Isolated Grounding Receptacle Circuits: Install an insulated equipment grounding conductor connected to the receptacle grounding terminal. Isolate conductor from raceway and from panelboard grounding terminals. Terminate at equipment grounding conductor terminal of the applicable derived system or service unless otherwise indicated.

E. Isolated Equipment Enclosure Circuits: For designated equipment supplied by a branch circuit or feeder, isolate equipment enclosure from supply circuit raceway with a nonmetallic raceway fitting listed for the purpose. Install fitting where raceway enters enclosure and install a separate insulated equipment grounding conductor. Isolate conductor from raceway and from panelboard grounding terminals. Terminate at equipment grounding conductor terminal of the applicable derived system or service unless otherwise indicated.

F. Poles Supporting Outdoor Lighting Fixtures: Install grounding electrode and a separate insulated equipment grounding conductor in addition to grounding conductor installed with branch-circuit conductors.

3.4 INSTALLATION

A. Grounding Conductors: Route along shortest and straightest paths possible unless otherwise indicated or required by Code. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.

B. Ground Bonding Common with Lightning Protection System: Comply with NFPA 780 and UL 96 when interconnecting with lightning protection system. Bond electrical power system ground directly to lightning protection system grounding conductor at closest point to electrical service grounding electrode. Use bonding conductor sized same as system grounding electrode conductor and install in conduit.

C. Ground Rods: Drive rods until tops are 2 inches below finished floor or final grade unless otherwise indicated.

1. Interconnect ground rods with grounding electrode conductor below grade and as otherwise indicated. Make connections without exposing steel or damaging coating if any.

2. Use exothermic welds for all below-grade connections.
3. For grounding electrode system, install at least three rods spaced at least one-rod length from each other and located at least the same distance from other grounding electrodes, and connect to the service grounding electrode conductor.

D. Bonding Straps and Jumpers: Install in locations accessible for inspection and maintenance except where routed through short lengths of conduit.

1. Bonding to Structure: Bond straps directly to basic structure, taking care not to penetrate any adjacent parts.
2. Bonding to Equipment Mounted on Vibration Isolation Hangers and Supports: Install bonding so vibration is not transmitted to rigidly mounted equipment.
3. Use exothermic-welded connectors for outdoor locations; if a disconnect-type connection is required, use a bolted clamp.

E. Grounding and Bonding for Piping:

1. Metal Water Service Pipe: Install insulated copper grounding conductors, in conduit, from building's main service equipment, or grounding bus, to main metal water service entrances to building. Connect grounding conductors to main metal water service pipes; use a bolted clamp connector or bolt a lug-type connector to a pipe flange by using one of the lug bolts of the flange. Where a dielectric main water fitting is installed, connect grounding conductor on street side of fitting. Bond metal grounding conductor conduit or sleeve to conductor at each end.
2. Water Meter Piping: Use braided-type bonding jumpers to electrically bypass water meters. Connect to pipe with a bolted connector.
3. Bond each aboveground portion of gas piping system downstream from equipment shutoff valve.

F. Bonding Interior Metal Ducts: Bond metal air ducts to equipment grounding conductors of associated fans, blowers, electric heaters, and air cleaners. Install bonding jumper to bond across flexible duct connections to achieve continuity.

G. Grounding for Steel Building Structure: Install a driven ground rod at base of each corner column and at intermediate exterior columns at distances not more than 60 feet apart.

H. Connections: Make connections so possibility of galvanic action or electrolysis is minimized. Select connectors, connection hardware, conductors, and connection methods so metals in direct contact are galvanically compatible.

1. Use electroplated or hot-tin-coated materials to ensure high conductivity and to make contact points closer in order of galvanic series.
2. Make connections with clean, bare metal at points of contact.
3. Make aluminum-to-steel connections with stainless-steel separators and mechanical clamps.
4. Make aluminum-to-galvanized-steel connections with tin-plated copper jumpers and mechanical clamps.
5. Coat and seal connections having dissimilar metals with inert material to prevent future penetration of moisture to contact surfaces.

3.5 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Tests and Inspections:

1. After installing grounding system but before permanent electrical circuits have been energized, test for compliance with requirements.
2. Inspect physical and mechanical condition. Verify tightness of accessible, bolted, electrical connections with a calibrated torque wrench according to manufacturer's written instructions.
3. Test completed grounding system at each location where a maximum ground-resistance level is specified, at service disconnect enclosure grounding terminal, at ground test wells, and at individual ground rods. Make tests at ground rods before any conductors are connected.

    a. Measure ground resistance no fewer than two full days after last trace of precipitation and without soil being moistened by any means other than natural drainage or seepage and without chemical treatment or other artificial means of reducing natural ground resistance.
    b. Perform tests by fall-of-potential method according to IEEE 81.

C. Grounding system will be considered defective if it does not pass tests and inspections.

D. Prepare test and inspection reports.

E. Report measured ground resistances that exceed the following values:

1. Power and Lighting Equipment or System with Capacity of 500 kVA and Less: 10 ohms.
2. Power and Lighting Equipment or System with Capacity of 500 to 1000 kVA: 5 ohms.
3. Power and Lighting Equipment or System with Capacity More Than 1000 kVA: 3 ohms.
4. Power Distribution Units or Panelboards Serving Electronic Equipment: 3 ohms.
5. Substations and Pad-Mounted Equipment: 5 ohms.

F. Excessive Ground Resistance: If resistance to ground exceeds specified values, notify Architect promptly and include recommendations to reduce ground resistance.

END OF SECTION 26 05 26

SECTION 26 05 29 - HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Steel slotted support systems.
2. Aluminum slotted support systems.
3. Conduit and cable support devices.
4. Support for conductors in vertical conduit.
5. Structural steel for fabricated supports and restraints.
6. Mounting, anchoring, and attachment components, including powder-actuated fasteners, mechanical expansion anchors, concrete inserts, clamps, through bolts, toggle bolts, and hanger rods.
7. Fabricated metal equipment support assemblies.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for the following:

a. Slotted support systems, hardware, and accessories.
b. Clamps.
c. Hangers.
d. Sockets.
e. Eye nuts.
f. Fasteners.
g. Anchors.
h. Saddles.
i. Brackets.

2. Include rated capacities and furnished specialties and accessories.

PART 2 - PRODUCTS

2.1 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS

A. Steel Slotted Support Systems: Preformed steel channels and angles with minimum 13/32-inch-diameter holes at a maximum of 8 inches o.c. in at least one surface.

1. Manufacturers: Subject to compliance with requirements, undefined:

a. Allied Tube & Conduit; a part of Atkore International.
b. B-line, an Eaton business.
c. Thomas & Betts Corporation; A Member of the ABB Group.
d. Unistrut; Part of Atkore International.

2. Standard: Comply with MFMA-4 factory-fabricated components for field assembly.
3. Material for Channel, Fittings, and Accessories: Galvanized steel.
4. Channel Width: Selected for applicable load criteria.
5. Metallic Coatings: Hot-dip galvanized after fabrication and applied according to MFMA-4.
6. Protect finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

B. Aluminum Slotted Support Systems: Extruded-aluminum channels and angles with minimum 13/32-inch- diameter holes at a maximum of 8 inches o.c. in at least one surface.

1. Manufacturers: Subject to compliance with requirements, undefined:

a. Cooper Industries, Inc.
b. Thomas & Betts Corporation; A Member of the ABB Group.
c. Unistrut; Part of Atkore International.

2. Standard: Comply with MFMA-4 factory-fabricated components for field assembly.
3. Channel Material: 6063-T5 aluminum alloy.
4. Fittings and Accessories Material: 5052-H32 aluminum alloy.
5. Channel Width: Selected for applicable load criteria.
6. Painted Coatings: Manufacturer's standard painted coating applied according to MFMA-4.
7. Protect finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

C. Conduit and Cable Support Devices: Steel hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported. Cable-ties shall be of the Type 21S per NEC 330.30(A).

D. Support for Conductors in Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug or plugs for nonarmored electrical conductors or cables in riser conduits. Plugs shall have number, size, and shape of conductor gripping pieces as required to suit individual conductors or cables supported. Body shall be made of malleable iron.

E. Structural Steel for Fabricated Supports and Restraints: ASTM A 36/A 36M steel plates, shapes, and bars; black and galvanized.

F. Mounting, Anchoring, and Attachment Components: Items for fastening electrical items or their supports to building surfaces include the following:

1. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete, steel, or wood, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used.

    a. Manufacturers: Subject to compliance with requirements, undefined:
        1) Hilti, Inc.
        2) ITW Ramset/Red Head; Illinois Tool Works, Inc.
        3) MKT Fastening, LLC.

2. Mechanical-Expansion Anchors: Insert-wedge-type, stainless steel, for use in hardened portland cement concrete, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used.

    a. Manufacturers: Subject to compliance with requirements, undefined:
        1) B-line, an Eaton business.
        2) Hilti, Inc.
        3) ITW Ramset/Red Head; Illinois Tool Works, Inc.
        4) MKT Fastening, LLC.

3. Concrete Inserts: Steel or malleable-iron, slotted support system units are similar to MSS Type 18 units and comply with MFMA-4 or MSS SP-58.
4. Clamps for Attachment to Steel Structural Elements: MSS SP-58 units are suitable for attached structural element.
5. Through Bolts: Structural type, hex head, and high strength. Comply with ASTM F 3125/F 3125M, Grade A325.
6. Hanger Rods: Threaded steel.

2.2 FABRICATED METAL EQUIPMENT SUPPORT ASSEMBLIES

A. Description: Welded or bolted structural-steel shapes, shop or field fabricated to fit dimensions of supported equipment.

B. Materials: Comply with requirements in Section 055000 "Metal Fabrications" for steel shapes and plates.

PART 3 - EXECUTION

3.1 APPLICATION

A. Comply with the following standards for application and installation requirements of hangers and supports, except where requirements on Drawings or in this Section are stricter:

    1) NECA 1.
    2) NECA 101
    3) NECA 102.
    4) NECA 105.
    5) NECA 111.

B. Comply with requirements in Section 078413 "Penetration Firestopping" for firestopping materials and installation for penetrations through fire-rated walls, ceilings, and assemblies.

C. Comply with requirements for raceways and boxes specified in Section 260533 "Raceways and Boxes for Electrical Systems."

D. Maximum Support Spacing and Minimum Hanger Rod Size for Raceways: Space supports for EMT, IMC, and RMC as required by NFPA 70. Minimum rod size shall be 1/4 inch in diameter.

E. Multiple Raceways or Cables: Install trapeze-type supports fabricated with steel slottedsupport system, sized so capacity can be increased by at least 25 percent in future without exceeding specified design load limits.

1. Secure raceways and cables to these supports with two-bolt conduit clamps.

F. Spring-steel clamps designed for supporting single conduits without bolts may be used for 1-1/2-inch and smaller raceways serving branch circuits and communication systems above suspended ceilings, and for fastening raceways to trapeze supports.

3.2 SUPPORT INSTALLATION

A. Comply with NECA 1 and NECA 101 for installation requirements except as specified in this article.

B. Raceway Support Methods: In addition to methods described in NECA 1, EMT IMC and RMC may be supported by openings through structure members, according to NFPA 70.

C. Strength of Support Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination shall be weight of supported components plus 200 lb .

D. Mounting and Anchorage of Surface-Mounted Equipment and Components: Anchor and fasten electrical items and their supports to building structural elements by the following methods unless otherwise indicated by code:

1. To Wood: Fasten with lag screws or through bolts.
2. To New Concrete: Bolt to concrete inserts.
3. To Masonry: Approved toggle-type bolts on hollow masonry units and expansion anchor fasteners on solid masonry units.
4. To Existing Concrete: Expansion anchor fasteners.
5. Instead of expansion anchors, powder-actuated driven threaded studs provided with lock washers and nuts may be used in existing standard-weight concrete 4 inches thick or greater. Do not use for anchorage to lightweight-aggregate concrete or for slabs less than 4 inches thick.
6. To Steel: Beam clamps (MSS SP-58, Type 19, 21, 23, 25, or 27), complying with MSS SP-69.

E. Drill holes for expansion anchors in concrete at locations and to depths that avoid the need for reinforcing bars.

3.3 INSTALLATION OF FABRICATED METAL SUPPORTS

A. Comply with installation requirements in Section 055000 "Metal Fabrications" for site-fabricated metal supports.

B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor electrical materials and equipment.

C. Field Welding: Comply with AWS D1.1/D1.1M.

3.4 CONCRETE BASES

A. Construct concrete bases of dimensions indicated, but not less than 4 inches larger in both directions than supported unit, and so anchors will be a minimum of 10 bolt diameters from edge of the base.

B. Use 3000 psi, 28-day compressive-strength concrete. Concrete materials, reinforcement, and placement requirements are specified in Section 033000 "Cast-in-Place Concrete."

C. Anchor equipment to concrete base as follows:

1. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
2. Install anchor bolts to elevations required for proper attachment to supported equipment.
3. Install anchor bolts according to anchor-bolt manufacturer's written instructions.

END OF SECTION 26 05 29

SECTION 26 05 33 - RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Metal conduits and fittings.
2. Nonmetallic conduits and fittings.
3. Metal wireways and auxiliary gutters.
4. Boxes, enclosures, and cabinets.
5. Handholes and boxes for exterior underground cabling.

B. Related Requirements:

1. "Penetration Firestopping" for firestopping at conduit and box entrances.
2. "Underground Ducts and Raceways for Electrical Systems" for exterior ductbanks, manholes, and underground utility construction.
3. "Pathways for Communications Systems" for conduits, wireways, surface pathways, innerduct, boxes, faceplate adapters, enclosures, cabinets, and handholes serving communications systems.

1.3 DEFINITIONS

A. ARC: Aluminum rigid conduit.

B. GRC: Galvanized rigid steel conduit.

C. IMC: Intermediate metal conduit.

1.4 ACTION SUBMITTALS

A. Product Data: For surface raceways, wireways and fittings, floor boxes, hinged-cover enclosures, and cabinets.

B. Shop Drawings: For custom enclosures and cabinets. Include plans, elevations, sections, and attachment details.

1.5 INFORMATIONAL SUBMITTALS

PART 2 - PRODUCTS

2.1 METAL CONDUITS AND FITTINGS

A. Metal Conduit:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Allied Tube & Conduit; a part of Atkore International.
    b. O-Z/Gedney; a brand of Emerson Industrial Automation.
    c. Southwire Company.
    d. Thomas & Betts Corporation; A Member of the ABB Group.
    e. Wheatland Tube Company.

2. Listing and Labeling: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
3. GRC: Comply with ANSI C80.1 and UL 6.
4. IMC: Comply with ANSI C80.6 and UL 1242.
5. PVC-Coated Steel Conduit: PVC-coated rigid steel conduit.

    a. Comply with NEMA RN 1.
    b. Coating Thickness: 0.040 inch, minimum.
6. EMT: Comply with ANSI C80.3 and UL 797.
7. FMC: Comply with UL 1; zinc-coated steel.
8. LFMC: Flexible steel conduit with PVC jacket and complying with UL 360.

B. Metal Fittings:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Allied Tube & Conduit; a part of Atkore International.
    b. O-Z/Gedney; a brand of Emerson Industrial Automation.
    c. Southwire Company.
    d. Thomas & Betts Corporation; A Member of the ABB Group.
    e. Wheatland Tube Company.

2. Comply with NEMA FB 1 and UL 514B.
3. Listing and Labeling: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
4. Fittings, General: Listed and labeled for type of conduit, location, and use.
5. Conduit Fittings for Hazardous (Classified) Locations: Comply with UL 1203 and NFPA 70.
6. Fittings for EMT:

    a. Material: Steel.
    b. Type: Setscrew or compression.

7. Expansion Fittings: PVC or steel to match conduit type, complying with UL 651, rated for environmental conditions where installed, and including flexible external bonding jumper.
8. Coating for Fittings for PVC-Coated Conduit: Minimum thickness of 0.040 inch, with overlapping sleeves protecting threaded joints.

C. Joint Compound for IMC, GRC, or ARC: Approved, as defined in NFPA 70, by authorities having jurisdiction for use in conduit assemblies, and compounded for use to lubricate and protect threaded conduit joints from corrosion and to enhance their conductivity.

2.2 NONMETALLIC CONDUITS AND FITTINGS

A. Nonmetallic Conduit:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. RACO; Hubbell.
    b. Thomas & Betts Corporation; A Member of the ABB Group.
    c. United Fiberglass.

2. Listing and Labeling: Nonmetallic conduit shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
3. Fiberglass:

    a. Comply with NEMA TC 14.
    b. Comply with UL 2515 for aboveground raceways.
    c. Comply with UL 2420 for belowground raceways.

4. ENT: Comply with NEMA TC 13 and UL 1653.
5. RNC: Type EPC-40-PVC, complying with NEMA TC 2 and UL 651 unless otherwise indicated.
6. LFNC: Comply with UL 1660.

B. Nonmetallic Fittings:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. RACO; Hubbell.
    b. Thomas & Betts Corporation; A Member of the ABB Group.
    c. United Fiberglass.

2. Fittings, General: Listed and labeled for type of conduit, location, and use.
3. Fittings for ENT and RNC: Comply with NEMA TC 3; match to conduit or tubing type and material.

    a. Fittings for LFNC: Comply with UL 514B.

4. Solvents and Adhesives: As recommended by conduit manufacturer.

2.3 METAL WIREWAYS AND AUXILIARY GUTTERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. B-line, an Eaton business.
2. Hoffman; a brand of nVent.
3. MonoSystems, Inc.

B. Description: Sheet metal, complying with UL 870 and NEMA 250, Type 1 Type 3R unless otherwise indicated, and sized according to NFPA 70.

1. Metal wireways installed outdoors shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. Fittings and Accessories: Include covers, couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings to match and mate with wireways as required for complete system.

D. Wireway Covers: Hinged type Screw-cover type unless otherwise indicated.

E. Finish: Manufacturer's standard enamel finish.

2.4 BOXES, ENCLOSURES, AND CABINETS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Crouse-Hinds, an Eaton business.
2. EGS/Appleton Electric.
3. Hoffman; a brand of nVent.
4. Hubbell Incorporated.
5. O-Z/Gedney; a brand of Emerson Industrial Automation.
6. RACO; Hubbell.
7. Thomas & Betts Corporation; A Member of the ABB Group.
8. Wiremold / Legrand.

B. General Requirements for Boxes, Enclosures, and Cabinets: Boxes, enclosures, and cabinets installed in wet locations shall be listed for use in wet locations.

C. Sheet Metal Outlet and Device Boxes: Comply with NEMA OS 1 and UL 514A.

D. Cast-Metal Outlet and Device Boxes: Comply with NEMA FB 1, aluminum, Type FD, with gasketed cover.

E. Nonmetallic Floor Boxes: Nonadjustable, rectangular or round, as indicated on Drawings.

1. Listing and Labeling: Nonmetallic floor boxes shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

F. Luminaire Outlet Boxes: Nonadjustable, designed for attachment of luminaire weighing 50 lb. Outlet boxes designed for attachment of luminaires weighing more than 50 lb shall be listed and marked for the maximum allowable weight.

G. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.

H. Cast-Metal Access, Pull, and Junction Boxes: Comply with NEMA FB 1 and UL 1773, cast aluminum with gasketed cover.

I. Device Box Dimensions: 4 inches square by 2-1/8 inches deep.

J. Gangable boxes are allowed.

K. Hinged-Cover Enclosures: Comply with UL 50 and NEMA 250, Type 1 Type 3R with continuous-hinge cover with flush latch unless otherwise indicated.

1. Metal Enclosures: Steel, finished inside and out with manufacturer's standard enamel.
2. Interior Panels: Steel; all sides finished with manufacturer's standard enamel.

L. Cabinets:

1. NEMA 250, Type 1 Type 3R galvanized-steel box with removable interior panel and removable front, finished inside and out with manufacturer's standard enamel.
2. Hinged door in front cover with flush latch and concealed hinge.
3. Key latch to match panelboards.
4. Metal barriers to separate wiring of different systems and voltage.
5. Accessory feet where required for freestanding equipment.
6. Nonmetallic cabinets shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.5 HANDHOLES AND BOXES FOR EXTERIOR UNDERGROUND WIRING

A. General Requirements for Handholes and Boxes:

1. Boxes and handholes for use in underground systems shall be designed and identified as defined in NFPA 70, for intended location and application.
2. Boxes installed in wet areas shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Polymer-Concrete Handholes and Boxes with Polymer-Concrete Cover: Molded of sand and aggregate, bound together with polymer resin, and reinforced with steel, fiberglass, or a combination of the two.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Armorcast Products Company.
b. Oldcastle Enclosure Solutions.
c. Quazite: Hubbell Power Systems, Inc.

2. Standard: Comply with SCTE 77.
3. Configuration: Designed for flush burial with closed bottom unless otherwise indicated.
4. Cover: Weatherproof, secured by tamper-resistant locking devices and having structural load rating consistent with enclosure and handhole location.
5. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.
6. Cover Legend: Molded lettering, "ELECTRIC.".

7. Conduit Entrance Provisions: Conduit-terminating fittings shall mate with entering ducts for secure, fixed installation in enclosure wall.
8. Handholes 12 Inches Wide by 24 Inches Long and Larger: Have inserts for cable racks and pulling-in irons installed before concrete is poured.

PART 3 - EXECUTION

3.1 RACEWAY APPLICATION

A. Outdoors: Apply raceway products as specified below unless otherwise indicated:

1. Exposed Conduit: GRC IMC.
2. Concealed Conduit, Aboveground: GRC IMC EMT RNC, Type EPC-40-PVC.
3. Underground Conduit: RNC, Type EPC-40-PVC, direct buried concrete encased.
4. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFNC.
5. Boxes and Enclosures, Aboveground: NEMA 250, Type 3R.

B. Indoors: Apply raceway products as specified below unless otherwise indicated:

1. Exposed, Not Subject to Physical Damage: EMT.
2. Exposed, Not Subject to Severe Physical Damage: EMT.
3. Exposed and Subject to Severe Physical Damage: IMC. Raceway locations include the following:

    a. Loading dock.
    b. Corridors used for traffic of mechanized carts, forklifts, and pallet-handling units.
    c. Mechanical rooms.
    d. Gymnasiums.

4. Concealed in Ceilings and Interior Walls and Partitions: EMT.
5. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): FMC, except use LFMC in damp or wet locations.
6. Damp or Wet Locations: IMC.
7. Boxes and Enclosures: NEMA 250, Type 1, except use NEMA 250, Type 4 stainless steel in institutional and commercial kitchens and damp or wet locations.

C. Minimum Raceway Size: 1/2-inch trade size.

D. Raceway Fittings: Compatible with raceways and suitable for use and location.

1. Rigid and Intermediate Steel Conduit: Use threaded rigid steel conduit fittings unless otherwise indicated. Comply with NEMA FB 2.10.
2. PVC Externally Coated, Rigid Steel Conduits: Use only fittings listed for use with this type of conduit. Patch and seal all joints, nicks, and scrapes in PVC coating after installing conduits and fittings. Use sealant recommended by fitting manufacturer and apply in thickness and number of coats recommended by manufacturer.
3. EMT: Use setscrew or compression, steel fittings. Comply with NEMA FB 2.10.
4. Flexible Conduit: Use only fittings listed for use with flexible conduit. Comply with NEMA FB 2.20.

E. Install nonferrous conduit or tubing for circuits operating above 60 Hz. Where aluminum raceways are installed for such circuits and pass through concrete, install in nonmetallic sleeve.

F. Do not install aluminum conduits, boxes, or fittings in contact with concrete or earth.

G. Install surface raceways only where indicated on Drawings.

H. Do not install nonmetallic conduit where ambient temperature exceeds 120 deg F.

3.2 INSTALLATION

A. Comply with requirements in Section 260529 "Hangers and Supports for Electrical Systems" for hangers and supports.

B. Comply with NECA 1 and NECA 101 for installation requirements except where requirements on Drawings or in this article are stricter. Comply with NECA 102 for aluminum conduits. Comply with NFPA 70 limitations for types of raceways allowed in specific occupancies and number of floors.

C. Do not install raceways or electrical items on any "explosion-relief" walls or rotating equipment.

D. Do not fasten conduits onto the bottom side of a metal deck roof.

E. Keep raceways at least 6 inches away from parallel runs of flues and steam or hot-water pipes. Install horizontal raceway runs above water and steam piping.

F. Complete raceway installation before starting conductor installation.

G. Arrange stub-ups so curved portions of bends are not visible above finished slab.

H. Install no more than the equivalent of three 90-degree bends in any conduit run except for control wiring conduits, for which fewer bends are allowed. Support within 12 inches of changes in direction.

I. Make bends in raceway using large-radius preformed ells. Field bending shall be according to NFPA 70 minimum radii requirements. Use only equipment specifically designed for material and size involved.

J. Conceal conduit within finished walls, ceilings, and floors unless otherwise indicated. Install conduits parallel or perpendicular to building lines.

K. Support conduit within 12 inches of enclosures to which attached.

L. Raceways Embedded in Slabs:

1. Run conduit larger than 1-inch trade size, parallel or at right angles to main reinforcement. Where at right angles to reinforcement, place conduit close to slab support. Secure raceways to reinforcement at maximum 10-foot intervals.
2. Arrange raceways to cross building expansion joints at right angles with expansion fittings.
3. Arrange raceways to keep a minimum of 2 inches of concrete cover in all directions.
4. Do not embed threadless fittings in concrete unless specifically approved by Architect for each specific location.
5. Change from ENT to IMC before rising above floor.

M. Stub-Ups to Above Recessed Ceilings:

1. Use EMT, IMC, or RMC for raceways.
2. Use a conduit bushing or insulated fitting to terminate stub-ups not terminated in hubs or in an enclosure.

N. Threaded Conduit Joints, Exposed to Wet, Damp, Corrosive, or Outdoor Conditions: Apply listed compound to threads of raceway and fittings before making up joints. Follow compound manufacturer's written instructions.

O. Coat field-cut threads on PVC-coated raceway with a corrosion-preventing conductive compound prior to assembly.

P. Raceway Terminations at Locations Subject to Moisture or Vibration: Use insulating bushings to protect conductors including conductors smaller than No. 4 AWG.

Q. Terminate threaded conduits into threaded hubs or with locknuts on inside and outside of boxes or cabinets. Install bushings on conduits up to 1-1/4-inch trade size and insulated throat metal bushings on 1-1/2-inch trade size and larger conduits terminated with locknuts. Install insulated throat metal grounding bushings on service conduits.

R. Install raceways square to the enclosure and terminate at enclosures with locknuts. Install locknuts hand tight plus 1/4 turn more.

S. Do not rely on locknuts to penetrate nonconductive coatings on enclosures. Remove coatings in the locknut area prior to assembling conduit to enclosure to assure a continuous ground path.

T. Cut conduit perpendicular to the length. For conduits 2-inch trade size and larger, use roll cutter or a guide to make cut straight and perpendicular to the length.

U. Install pull wires in empty raceways. Use polypropylene or monofilament plastic line with not less than 200-lb tensile strength. Leave at least 12 inches of slack at each end of pull wire. Cap underground raceways designated as spare above grade alongside raceways in use.

V. Surface Raceways:

1. Install surface raceway with a minimum 2-inch radius control at bend points.
2. Secure surface raceway with screws or other anchor-type devices at intervals not exceeding 48 inches and with no less than two supports per straight raceway section. Support surface raceway according to manufacturer's written instructions. Tape and glue are not acceptable support methods.

W. Install raceway sealing fittings at accessible locations according to NFPA 70 and fill them with listed sealing compound. For concealed raceways, install each fitting in a flush steel box with a blank cover plate having a finish similar to that of adjacent plates or surfaces. Install raceway sealing fittings according to NFPA 70.

X. Install devices to seal raceway interiors at accessible locations. Locate seals so no fittings or boxes are between the seal and the following changes of environments. Seal the interior of all raceways at the following points:

1. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.
2. Where an underground service raceway enters a building or structure.

3. Conduit extending from interior to exterior of building.
4. Conduit extending into pressurized duct and equipment.
5. Conduit extending into pressurized zones that are automatically controlled to maintain different pressure set points.
6. Where otherwise required by NFPA 70.

Y. Comply with manufacturer's written instructions for solvent welding RNC and fittings.

Z. Expansion-Joint Fittings:

1. Install in each run of aboveground RNC that is located where environmental temperature change may exceed 30 deg F and that has straight-run length that exceeds 25 feet. Install in each run of aboveground RMC and EMT conduit that is located where environmental temperature change may exceed 100 deg F and that has straight-run length that exceeds 100 feet.
2. Install type and quantity of fittings that accommodate temperature change listed for each of the following locations:

    a. Outdoor Locations Not Exposed to Direct Sunlight: 125 deg F temperature change.
    b. Outdoor Locations Exposed to Direct Sunlight: 155 deg F temperature change.
    c. Indoor Spaces Connected with Outdoors without Physical Separation: 125 deg F temperature change.
    d. Attics: 135 deg F temperature change.

3. Install fitting(s) that provide expansion and contraction for at least 0.00041 inch per foot of length of straight run per deg F of temperature change for PVC conduits. Install fitting(s) that provide expansion and contraction for at least 0.000078 inch per foot of length of straight run per deg F of temperature change for metal conduits.
4. Install expansion fittings at all locations where conduits cross building or structure expansion joints.
5. Install each expansion-joint fitting with position, mounting, and piston setting selected according to manufacturer's written instructions for conditions at specific location at time of installation. Install conduit supports to allow for expansion movement.

AA. Flexible Conduit Connections: Comply with NEMA RV 3. Use a maximum of 72 inches of flexible conduit for recessed and semirecessed luminaires, equipment subject to vibration, noise transmission, or movement; and for transformers and motors.

1. Use LFMC in damp or wet locations subject to severe physical damage.
2. Use LFMC or LFNC in damp or wet locations not subject to severe physical damage.

BB. Mount boxes at heights indicated on Drawings. If mounting heights of boxes are not individually indicated, give priority to ADA requirements. Install boxes with height measured to center of box unless otherwise indicated.

CC. Recessed Boxes in Masonry Walls: Saw-cut opening for box in center of cell of masonry block and install box flush with surface of wall. Prepare block surfaces to provide a flat surface for a raintight connection between box and cover plate or supported equipment and box.

DD. Horizontally separate boxes mounted on opposite sides of walls so they are not in the same vertical channel.

EE. Locate boxes so that cover or plate will not span different building finishes.

FF. Support boxes of three gangs or more from more than one side by spanning two framing members or mounting on brackets specifically designed for the purpose.

GG. Fasten junction and pull boxes to or support from building structure. Do not support boxes by conduits.

HH. Set metal floor boxes level and flush with finished floor surface.

II. Set nonmetallic floor boxes level. Trim after installation to fit flush with finished floor surface.

3.3 INSTALLATION OF UNDERGROUND CONDUIT

A. Direct-Buried Conduit:

1. Excavate trench bottom to provide firm and uniform support for conduit. Prepare trench bottom as specified in Section 312000 "Earth Moving" for pipe less than 6 inches in nominal diameter.
2. Install backfill as specified in Section 312000 "Earth Moving."
3. After installing conduit, backfill and compact. Start at tie-in point, and work toward end of conduit run, leaving conduit at end of run free to move with expansion and contraction as temperature changes during this process. Firmly hand tamp backfill around conduit to provide maximum supporting strength. After placing controlled backfill to within 12 inches of finished grade, make final conduit connection at end of run and complete backfilling with normal compaction as specified in Section 312000 "Earth Moving."
4. Install manufactured duct elbows for stub-ups at poles and equipment and at building entrances through floor unless otherwise indicated. Encase elbows for stub-up ducts throughout length of elbow.
5. Install manufactured rigid steel conduit elbows for stub-ups at poles and equipment and at building entrances through floor.
    a. Couple steel conduits to ducts with adapters designed for this purpose and encase coupling with 3 inches of concrete for a minimum of 12 inches on each side of the coupling.
    b. For stub-ups at equipment mounted on outdoor concrete bases and where conduits penetrate building foundations, extend steel conduit horizontally a minimum of 60 inches from edge of foundation or equipment base. Install insulated grounding bushings on terminations at equipment.
6. Warning Planks: Bury warning planks approximately 12 inches above direct-buried conduits but a minimum of 6 inches below grade. Align planks along centerline of conduit.
7. Underground Warning Tape: Comply with requirements in Section 260553 "Identification for Electrical Systems."

3.4 INSTALLATION OF UNDERGROUND HANDHOLES AND BOXES

A. Install handholes and boxes level and plumb and with orientation and depth coordinated with connecting conduits to minimize bends and deflections required for proper entrances.

B. Unless otherwise indicated, support units on a level bed of crushed stone or gravel, graded from 1/2-inch sieve to No. 4 sieve and compacted to same density as adjacent undisturbed earth.

C. Elevation: In paved areas, set so cover surface will be flush with finished grade. Set covers of other enclosures 1 inch above finished grade.

D. Install handholes with bottom below frost line

E. Install removable hardware, including pulling eyes, cable stanchions, cable arms, and insulators, as required for installation and support of cables and conductors and as indicated. Select arm lengths to be long enough to provide spare space for future cables but short enough to preserve adequate working clearances in enclosure.

F. Field-cut openings for conduits according to enclosure manufacturer's written instructions. Cut wall of enclosure with a tool designed for material to be cut. Size holes for terminating fittings to be used, and seal around penetrations after fittings are installed.

3.5 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR ELECTRICAL PENETRATIONS

A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies. Comply with requirements in Section 260544 "Sleeves and Sleeve Seals for Electrical Raceways and Cabling."

3.6 FIRESTOPPING

A. Install firestopping at penetrations of fire-rated floor and wall assemblies. Comply with requirements in Section 078413 "Penetration Firestopping."

3.7 PROTECTION

A. Protect coatings, finishes, and cabinets from damage and deterioration.

1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
2. Repair damage to PVC coatings or paint finishes with matching touchup coating recommended by manufacturer.

END OF SECTION 26 05 33

SECTION 26 05 43 - UNDERGROUND DUCTS AND RACEWAYS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Metal conduits and fittings, including GRC and PVC-coated steel conduit.
2. Rigid nonmetallic duct.
3. Flexible nonmetallic duct.
4. Duct accessories.
5. Polymer concrete handholes and boxes with polymer concrete cover.

1.3 DEFINITIONS

A. Direct Buried: Duct or a duct bank that is buried in the ground, without any additional casing materials such as concrete.

B. Duct: A single duct or multiple ducts. Duct may be either installed singly or as component of a duct bank.

C. Duct Bank:

1. Two or more ducts installed in parallel, with or without additional casing materials.
2. Multiple duct banks.

D. GRC: Galvanized rigid (steel) conduit.

E. Trafficways: Locations where vehicular or pedestrian traffic is a normal course of events.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include duct-bank materials, including spacers and miscellaneous components.
2. Include duct, conduits, and their accessories, including elbows, end bells, bends, fittings, and solvent cement.
3. Include accessories for handholes and boxes.
4. Include underground-line warning tape.

B. Shop Drawings:

1. Factory-Fabricated Handholes and Boxes Other Than Precast Concrete:

a. Include dimensioned plans, sections, and elevations, and fabrication and installation details.
b. Include duct entry provisions, including locations and duct sizes.
c. Include cover design.
d. Include grounding details.
e. Include dimensioned locations of cable rack inserts, and pulling-in and lifting irons.

1.5 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: For duct and duct bank. Show duct profiles and coordination with other utilities and underground structures.

1. Include plans and sections, drawn to scale, and show bends and locations of expansion fittings.
2. Drawings shall be signed and sealed by a qualified professional engineer.

B. Product Certificates: For concrete and steel used in precast concrete handholes, as required by ASTM C858.

C. Source quality-control reports.

D. Field quality-control reports.

1.6 MAINTENANCE MATERIALS SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1.7 QUALITY ASSURANCE

A. Testing Agency Qualifications: Qualified according to ASTM E329 for testing indicated.

1.8 FIELD CONDITIONS

A. Interruption of Existing Electrical Service: Do not interrupt electrical service to facilities occupied by Owner or others unless permitted under the following conditions, and then only after arranging to provide temporary electrical service according to requirements indicated:

1. Notify Architect no fewer than ten days in advance of proposed interruption of electrical service.
2. Do not proceed with interruption of electrical service without Architect's written permission.

B. Ground Water: Assume ground-water level is at grade level unless a lower water table is noted on Drawings.

C. Ground Water: Assume ground-water level is 36 inches (900 mm) below ground surface unless a higher water table is noted on Drawings.

PART 2 - PRODUCTS

2.1 METAL CONDUIT AND FITTINGS

A. GRC: Comply with ANSI C80.1 and UL 6.

B. Coated Steel Conduit: PVC-coated GRC.

1. Comply with NEMA RN 1.
2. Coating Thickness: 0.040 inch (1 mm), minimum.

C. Listed and labeled as defined in NFPA 70, by a nationally recognized testing laboratory, and marked for intended location and application.

2.2 RIGID NONMETALLIC DUCT

A. Underground Plastic Utilities Duct: Type EPC-40-PVC RNC, complying with NEMA TC 2 and UL 651, with matching fittings complying with NEMA TC 3 by same manufacturer as duct.

B. Listed and labeled as defined in NFPA 70, by a nationally recognized testing laboratory, and marked for intended location and application.

C. Solvents and Adhesives: As recommended by conduit manufacturer.

2.3 FLEXIBLE NONMETALLIC DUCTS

A. HDPE Duct: Type EPEC-40 HDPE complying with NEMA TC 7 and UL 651A.

1. Listed and labeled as defined in NFPA 70, by a nationally recognized testing laboratory, and marked for intended location and application.

2.4 DUCT ACCESSORIES

A. Duct Spacers: Factory-fabricated, rigid, PVC interlocking spacers; sized for type and size of duct with which used and selected to provide minimum duct spacing indicated while supporting duct during concreting or backfilling.

B. Underground-Line Warning Tape: Comply with requirements for underground-line warning tape specified in Section 260553 "Identification for Electrical Systems."

2.5 POLYMER CONCRETE HANDHOLES AND BOXES WITH POLYMER CONCRETE COVER

A. Description: Molded of sand and aggregate, bound together with a polymer resin, and reinforced with steel or fiberglass or a combination of the two.

B. Standard: Comply with SCTE 77. Comply with tier requirements in "Underground Enclosure Application" Article.

C. Color: Gray.

D. Configuration: Units shall be designed for flush burial and have open bottom unless otherwise indicated.

E. Cover: Weatherproof, secured by tamper-resistant locking devices and having structural load rating consistent with enclosure.

F. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.

G. Cover Legend: Molded lettering, as indicated for each service.

H. Direct-Buried Wiring Entrance Provisions: Knockouts equipped with insulated bushings or end-bell fittings, selected to suit box material, sized for wiring indicated, and arranged for secure, fixed installation in enclosure wall.

I. Duct Entrance Provisions: Duct-terminating fittings shall mate with entering duct for secure, fixed installation in enclosure wall.

J. Handholes 12 inches wide by 24 inches long (300 mm wide by 600 mm long) and larger shall have factory-installed inserts for cable racks and pulling-in irons.

PART 3 - EXECUTION

3.1 PREPARATION

A. Coordinate layout and installation of duct, duct bank, manholes, handholes, and boxes with final arrangement of other utilities, site grading, and surface features as determined in the field. Notify Architect if there is a conflict between areas of excavation and existing structures or archaeological sites to remain.

B. Coordinate elevations of duct and duct-bank entrances into manholes, handholes, and boxes with final locations and profiles of duct and duct banks, as determined by coordination with other utilities, underground obstructions, and surface features. Revise locations and elevations as required to suit field conditions and to ensure that duct and duct bank will drain to manholes and handholes, and as approved by Architect.

C. Clear and grub vegetation to be removed and protect vegetation to remain according to Section 311000 "Site Clearing." Remove and stockpile topsoil for reapplication according to Section 311000 "Site Clearing."

3.2 UNDERGROUND DUCT APPLICATION

A. Duct for Electrical Feeders 600 V and Less: Type EPC-40-PVC RNC, direct-buried unless otherwise indicated.

B. Duct for Electrical Branch Circuits: Type EPC-40-PVC RNC, direct-buried unless otherwise indicated.

C. Bored Underground Duct: Type EPEC-40-HDPE unless otherwise indicated.

D. Underground Ducts Crossing Paved Paths, Walkways, and Driveways: Type EPC-40 PVC RNC, encased in reinforced concrete.

E. Stub-ups: Concrete-encased GRC with corrosion protection.

3.3 UNDERGROUND ENCLOSURE APPLICATION

A. Handholes and Boxes for 600 V and Less:

1. Units in Roadways and Other Deliberate Traffic Paths: Precast concrete. AASHTO HB 17, H-20 structural load rating.
2. Units in Driveway, Parking Lot, and Off-Roadway Locations, Subject to Occasional, Nondeliberate Loading by Heavy Vehicles: Polymer concrete, SCTE 77, Tier 15 structural load rating.
3. Units in Sidewalk and Similar Applications with a Safety Factor for Nondeliberate Loading by Vehicles: Polymer concrete units, SCTE 77, Tier 8 structural load rating.
4. Cover design load shall not exceed the design load of the handhole or box.

5. Units Located in Roadways and Other Deliberate Traffic Paths by Heavy or Medium Vehicles: H-20 structural load rating according to AASHTO HB 17.
6. Units Not Located in Deliberate Traffic Paths by Heavy or Medium Vehicles: H-10 load rating according to AASHTO HB 17.

3.4 EARTHWORK

A. Excavation and Backfill: Comply with Section 312000 "Earth Moving," but do not use heavy-duty, hydraulic-operated, compaction equipment.

B. Restoration: Replace area after construction vehicle traffic in immediate area is complete.

C. Restore surface features at areas disturbed by excavation, and re-establish original grades unless otherwise indicated. Replace removed sod immediately after backfilling is completed.

D. Restore areas disturbed by trenching, storing of dirt, cable laying, and other work. Restore vegetation and include necessary topsoiling, fertilizing, liming, seeding, sodding, sprigging, and mulching. Comply with Section 329200 "Turf and Grasses" and Section 329300 "Plants."

E. Cut and patch existing pavement in the path of underground duct, duct bank, and underground structures according to "Cutting and Patching" Article in Section 017300 "Execution."

3.5 DUCT AND DUCT-BANK INSTALLATION

A. Where indicated on Drawings, install duct, spacers, and accessories into the duct-bank configuration shown. Duct installation requirements in this Section also apply to duct bank.

B. Install duct according to NEMA TCB 2.

C. Slope: Pitch duct a minimum slope of 1:300 down toward manholes and handholes and away from buildings and equipment. Slope duct from a high point between two manholes, to drain in both directions.

D. Curves and Bends: Use 5-degree angle couplings for small changes in direction. Use manufactured long sweep bends with a minimum radius of 48 inches (1200 mm), both horizontally and vertically, at other locations unless otherwise indicated.

1. Duct shall have maximum of two 90 degree bends or the total of all bends shall be no more 180 degrees between pull points.

E. Joints: Use solvent-cemented joints in duct and fittings and make watertight according to manufacturer's written instructions. Stagger couplings so those of adjacent duct do not lie in same plane.

F. Installation Adjacent to High-Temperature Steam Lines: Where duct is installed parallel to underground steam lines, perform calculations showing the duct will not be subject to environmental temperatures above 40 deg C. Where environmental temperatures are calculated to rise above 40 deg C, and anywhere the duct crosses above an underground steam line, install insulation blankets listed for direct burial to isolate the duct bank from the steam line.

G. End Bell Entrances to Manholes and Concrete and Polymer Concrete Handholes: Use end bells, spaced approximately 10 inches (250 mm) o.c. for 5-inch (125-mm) duct, and vary proportionately for other duct sizes.

1. Begin change from regular spacing to end-bell spacing 10 feet (3 m) from the end bell, without reducing duct slope and without forming a trap in the line.

2. Grout end bells into structure walls from both sides to provide watertight entrances.

H. Building Wall Penetrations: Make a transition from underground duct to GRC at least 10 feet (3 m) outside the building wall, without reducing duct line slope away from the building and without forming a trap in the line. Use fittings manufactured for RNC-to-GRC transition. Install GRC penetrations of building walls as specified in Section 260544 "Sleeves and Sleeve Seals for Electrical Raceways and Cabling."

I. Sealing: Provide temporary closure at terminations of duct with pulled cables. Seal spare duct at terminations. Use sealing compound and plugs to withstand at least 15-psig (1.03-MPa) hydrostatic pressure.

J. Pulling Cord: Install 200-lbf- (1000-N-) test nylon cord in empty ducts.

K. Direct-Buried Duct and Duct Bank:

1. Excavate trench bottom to provide firm and uniform support for duct. Comply with requirements in Section 312000 "Earth Moving" for preparation of trench bottoms for pipes less than 6 inches (150 mm) in nominal diameter.
2. Width: Excavate trench 12 inches (300 mm) wider than duct on each side.
3. Width: Excavate trench 3 inches (75 mm) wider than duct on each side.

4. Depth: Install top of duct at least 36 inches (900 mm) below finished grade unless otherwise indicated.
5. Set elevation of bottom of duct bank below frost line.
6. Support ducts on duct spacers coordinated with duct size, duct spacing, and outdoor temperature.

7. Spacer Installation: Place spacers close enough to prevent sagging and deforming of duct, with not less than four spacers per 20 feet (6 m) of duct. Place spacers within 24 inches

(600 mm) of duct ends. Stagger spacers approximately 6 inches (150 mm) between tiers. Secure spacers to earth and to ducts to prevent floating during concreting. Tie entire assembly together using fabric straps; do not use tie wires or reinforcing steel that may form conductive or magnetic loops around ducts or duct groups.

8. Install duct with a minimum of 3 inches (75 mm) between ducts for like services and 6 inches (150 mm) between power and communications duct.

9. Elbows: Install manufactured duct elbows for stub-ups, at building entrances, and at changes of direction in duct direction unless otherwise indicated. Encase elbows for stub-up ducts throughout length of elbow.
10. Install manufactured GRC elbows for stub-ups, at building entrances, and at changes of direction in duct.

    a. Couple RNC duct to GRC with adapters designed for this purpose, and encase coupling with 3 inches (75 mm) of concrete.
    b. Stub-ups to Outdoor Equipment: Extend concrete-encased GRC horizontally a minimum of 60 inches (1500 mm) from edge of base. Install insulated grounding bushings on terminations at equipment.

        1) Stub-ups shall be minimum 4 inches (100 mm) above finished floor and minimum 3 inches (75 mm)from conduit side to edge of slab.

    c. Stub-ups to Indoor Equipment: Extend concrete-encased GRC horizontally a minimum of 60 inches (1500 mm) from edge of wall. Install insulated grounding bushings on terminations at equipment.

        1) Stub-ups shall be minimum 4 inches (100 mm) above finished floor and no less than 3 inches (75 mm)from conduit side to edge of slab.

11. After installing first tier of duct, backfill and compact. Start at tie-in point and work toward end of duct run, leaving ducts at end of run free to move with expansion and contraction as temperature changes during this process. Repeat procedure after placing each tier. After placing last tier, hand place backfill to 4 inches (100 mm) over duct and hand tamp. Firmly tamp backfill around ducts to provide maximum supporting strength. Use hand tamper only. After placing controlled backfill over final tier, make final duct connections at end of run and complete backfilling with normal compaction. Comply with requirements in Section 312000 "Earth Moving" for installation of backfill materials.

    a. Place minimum 3 inches (75 mm) of sand as a bed for duct. Place sand to a minimum of 6 inches (150 mm) above top level of duct.

L. Underground-Line Warning Tape: Bury **conducting** underground line specified in Section 260553 "Identification for Electrical Systems" no less than 12 inches (300 mm) above all concrete-encased duct and duct banks. Align tape parallel to and within 3 inches (75 mm) of centerline of duct bank. Provide an additional warning tape for each 12-inch (300-mm) increment of duct-bank width over a nominal 18 inches (450 mm). Space additional tapes 12 inches (300 mm) apart, horizontally.

3.6 INSTALLATION OF HANDHOLES AND BOXES OTHER THAN PRECAST CONCRETE

A. Install handholes and boxes level and plumb and with orientation and depth coordinated with connecting duct, to minimize bends and deflections required for proper entrances. Use box extension if required to match depths of duct, and seal joint between box and extension as recommended by manufacturer.

B. Unless otherwise indicated, support units on a level bed of crushed stone or gravel, graded from 1/2-inch (12.5-mm) sieve to No. 4 (4.75-mm) sieve and compacted to same density as adjacent undisturbed earth.

C. Elevation: In paved areas and trafficways, set cover flush with finished grade. Set covers of other handholes 1 inch (25 mm) above finished grade.

D. Install handholes and boxes with bottom below frost line.

E. Install removable hardware, including pulling eyes, cable stanchions, cable arms, and insulators, as required for installation and support of cables and conductors and as indicated. Select arm lengths to be long enough to provide spare space for future cables, but short enough to preserve adequate working clearances in enclosure.

F. Field cut openings for duct according to enclosure manufacturer's written instructions. Cut wall of enclosure with a tool designed for material to be cut. Size holes for terminating fittings to be used, and seal around penetrations after fittings are installed.

3.7 GROUNDING

A. Ground underground ducts and utility structures according to Section 260526 "Grounding and Bonding for Electrical Systems."

3.8 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:

1. Demonstrate capability and compliance with requirements on completion of installation of underground duct, duct bank, and utility structures.
2. Pull solid aluminum or wood test mandrel through duct to prove joint integrity and adequate bend radii, and test for out-of-round duct. Provide a minimum 12-inch- (300-mm-) long mandrel equal to duct size minus 1/4 inch (6 mm). If obstructions are indicated, remove obstructions and retest.
3. Test handhole grounding to ensure electrical continuity of grounding and bonding connections. Measure and report ground resistance as specified in Section 260526 "Grounding and Bonding for Electrical Systems."

B. Correct deficiencies and retest as specified above to demonstrate compliance.

C. Prepare test and inspection reports.

3.9 CLEANING

A. Pull leather-washer-type duct cleaner, with graduated washer sizes, through full length of duct until duct cleaner indicates that duct is clear of dirt and debris. Follow with rubber duct swab for final cleaning and to assist in spreading lubricant throughout ducts.

B. Clean internal surfaces of manholes, including sump.

1. Sweep floor, removing dirt and debris.
2. Remove foreign material.

END OF SECTION 26 05 43

SECTION 26 05 44 - SLEEVES AND SLEEVE SEALS FOR ELECTRICAL RACEWAYS AND CABLING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Sleeves for raceway and cable penetration of non-fire-rated construction walls and floors.
2. Sleeve-seal systems.
3. Sleeve-seal fittings.
4. Grout.
5. Silicone sealants.

B. Related Requirements:

1. "Penetration Firestopping" for penetration firestopping installed in fire-resistance-rated walls, horizontal assemblies, and smoke barriers, with and without penetrating items.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

PART 2 - PRODUCTS

2.1 SLEEVES

A. Wall Sleeves:

1. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, zinc coated, plain ends.

B. Sleeves for Conduits Penetrating Non-Fire-Rated Gypsum Board Assemblies: Galvanized-steel sheet; 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint, with tabs for screw-fastening the sleeve to the board.

C. PVC-Pipe Sleeves: ASTM D 1785, Schedule 40.

2.2 SLEEVE-SEAL SYSTEMS

A. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and raceway or cable.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Advance Products & Systems, Inc.
    b. Metraflex Company (The).
    c. Pipeline Seal and Insulator, Inc.

2. Sealing Elements: EPDM rubber interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
3. Pressure Plates: Carbon steel.
4. Connecting Bolts and Nuts: Carbon steel, with corrosion-resistant coating, of length required to secure pressure plates to sealing elements.

2.3 SLEEVE-SEAL FITTINGS

A. Description: Manufactured plastic, sleeve-type, waterstop assembly made for embedding in concrete slab or wall. Unit shall have plastic or rubber waterstop collar with center opening to match piping OD.

1. Manufacturers: Subject to compliance with requirements, provide products by the following:

    a. Emerson
    b. Innerlynx, Eaton Crouse-Hinds, a Cooper Industries Company
    c. Link-Seal, GPT an EnPro Industries Company
    d. Metraflex

2.4 GROUT

A. Description: Nonshrink; recommended for interior and exterior sealing openings in non-fire-rated walls or floors.

B. Standard: ASTM C 1107/C 1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.

C. Design Mix: 5000-psi, 28-day compressive strength.

D. Packaging: Premixed and factory packaged.

2.5 SILICONE SEALANTS

A. Silicone Sealants: Single-component, silicone-based, neutral-curing elastomeric sealants of grade indicated below.

1. Grade: Pourable (self-leveling) formulation for openings in floors and other horizontal surfaces that are not fire rated.

2. Sealant shall have a VOC content of 50 g/L or less.

B. Silicone Foams: Multicomponent, silicone-based liquid elastomers that, when mixed, expand and cure in place to produce a flexible, nonshrinking foam.

PART 3 - EXECUTION

3.1 SLEEVE INSTALLATION FOR NON-FIRE-RATED ELECTRICAL PENETRATIONS

A. Comply with NECA 1.

B. Comply with NEMA VE 2 for cable tray and cable penetrations.

C. Sleeves for Conduits Penetrating Above-Grade Non-Fire-Rated Concrete and Masonry-Unit Floors and Walls:

1. Interior Penetrations of Non-Fire-Rated Walls and Floors:

a. Seal annular space between sleeve and raceway or cable, using joint sealant appropriate for size, depth, and location of joint. Comply with requirements in Section 079200 "Joint Sealants."
b. Seal space outside of sleeves with mortar or grout. Pack sealing material solidly between sleeve and wall so no voids remain. Tool exposed surfaces smooth; protect material while curing.

2. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.
3. Size pipe sleeves to provide 1/4-inch annular clear space between sleeve and raceway or cable unless sleeve seal is to be installed.
4. Install sleeves for wall penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of walls. Cut sleeves to length for mounting flush with both surfaces of walls. Deburr after cutting.

D. Sleeves for Conduits Penetrating Non-Fire-Rated Gypsum Board Assemblies:

1. Use circular metal sleeves unless penetration arrangement requires rectangular sleeved opening.
2. Seal space outside of sleeves with approved joint compound for gypsum board assemblies.

E. Roof-Penetration Sleeves: Seal penetration of individual raceways and cables with flexible boot-type flashing units applied in coordination with roofing work.

F. Aboveground, Exterior-Wall Penetrations: Seal penetrations using steel pipe sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.

G. Underground, Exterior-Wall and Floor Penetrations: Install cast-iron pipe sleeves. Size sleeves to allow for 1-inch annular clear space between raceway or cable and sleeve for installing sleeve-seal system.

3.2 SLEEVE-SEAL-SYSTEM INSTALLATION

A. Install sleeve-seal systems in sleeves in exterior concrete walls and slabs-on-grade at raceway entries into building.

B. Install type and number of sealing elements recommended by manufacturer for raceway or cable material and size. Position raceway or cable in center of sleeve. Assemble mechanical sleeve seals and install in annular space between raceway or cable and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

3.3 SLEEVE-SEAL-FITTING INSTALLATION

A. Install sleeve-seal fittings in new walls and slabs as they are constructed.

B. Assemble fitting components of length to be flush with both surfaces of concrete slabs and walls. Position waterstop flange to be centered in concrete slab or wall.

C. Secure nailing flanges to concrete forms.

D. Using grout, seal the space around outside of sleeve-seal fittings.

END OF SECTION 26 05 44

SECTION 26 05 53 - IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Color and legend requirements for raceways, conductors, and warning labels and signs.
2. Labels.
3. Bands and tubes.
4. Tapes and stencils.
5. Tags.
6. Signs.
7. Cable ties.
8. Paint for identification.
9. Fasteners for labels and signs.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Samples: For each type of label and sign to illustrate composition, size, colors, lettering style, mounting provisions, and graphic features of identification products.

C. Delegated-Design Submittal: For arc-flash hazard study.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Comply with ASME A13.1 and IEEE C2.

B. Comply with NFPA 70.

C. Comply with 29 CFR 1910.144 and 29 CFR 1910.145.

D. Comply with ANSI Z535.4 for safety signs and labels.

E. Comply with NFPA 70E and "Arc-Flash Hazard Analysis" requirements for arc-flash warning labels.

F. Adhesive-attached labeling materials, including label stocks, laminating adhesives, and inks used by label printers, shall comply with UL 969.

G. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes.

1. Temperature Change: 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.

2.2 COLOR AND LEGEND REQUIREMENTS

A. Raceways and Cables Carrying Circuits at 600 V or Less:

1. Black letters on a white field.
2. Legend: Indicate voltage and system or service type.

B. Color-Coding for Phase- and Voltage-Level Identification, 600 V or Less: Use colors listed below for ungrounded service, feeder and branch-circuit conductors.

1. Color shall be factory applied or field applied for sizes larger than No. 8 AWG if authorities having jurisdiction permit.
2. Colors for 208/120-V Circuits:

a. Phase A: Black.
b. Phase B: Red.
c. Phase C: Blue.

3. Color for Neutral: White.
4. Color for Equipment Grounds: Bare copper, Green, or Green with a yellow stripe.

C. Warning Label Colors:

1. Identify system voltage with black letters on an orange background.

D. Warning labels and signs shall include, but are not limited to, the following legends:

1. Multiple Power Source Warning: "DANGER - ELECTRICAL SHOCK HAZARD - EQUIPMENT HAS MULTIPLE POWER SOURCES."
2. Workspace Clearance Warning: "WARNING - OSHA REGULATION - AREA IN FRONT OF ELECTRICAL EQUIPMENT MUST BE KEPT CLEAR FOR 36 INCHES."

E. Equipment Identification Labels:

1. Normal Power: Black letters on a White field.

2. Emergency Power: White Letters on a Red field.

2.3 LABELS

A. Vinyl Wraparound Labels: Preprinted, flexible labels laminated with a clear, weather- and chemical-resistant coating and matching wraparound clear adhesive tape for securing label ends.

B. Snap-around Labels: Slit, pretensioned, flexible, preprinted, color-coded acrylic sleeves, with diameters sized to suit diameter and that stay in place by gripping action.

C. Self-Adhesive Wraparound Labels: Preprinted, 3-mil thick, vinyl flexible label with acrylic pressure-sensitive adhesive.

1. Self-Lamination: Clear; UV-, weather- and chemical-resistant; self-laminating, protective shield over the legend. Labels sized such that the clear shield overlaps the entire printed legend.
2. Marker for Labels: Machine-printed, permanent, waterproof, black ink recommended by printer manufacturer.

D. Self-Adhesive Labels: Vinyl, thermal, transfer-printed, 3.5-mil thick, multicolor, weather- and UV-resistant, pressure-sensitive adhesive labels, configured for intended use and location.
1. Minimum Nominal Size:

a. 1-1/2 by 6 inches for raceway and conductors.
b. 3-1/2 by 5 inches for equipment.
c. As required by authorities having jurisdiction.

2.4 BANDS AND TUBES

A. Snap-around, Color-Coding Bands: Slit, pretensioned, flexible, solid-colored acrylic sleeves, 2 inches long, with diameters sized to suit diameter and that stay in place by gripping action.

B. Heat-Shrink Preprinted Tubes: Flame-retardant polyolefin tubes with machine-printed identification labels, sized to suit diameters of and shrunk to fit firmly around item being identified. Full shrink recovery occurs at a maximum of 200 deg F. Comply with UL 224.

2.5 TAPES AND STENCILS

A. Marker Tapes: Vinyl or vinyl-cloth, self-adhesive wraparound type, with circuit identification legend machine printed by thermal transfer or equivalent process.

B. Self-Adhesive Vinyl Tape: Colored, heavy duty, waterproof, fade resistant; not less than 3 mils thick by 1 to 2 inches wide; compounded for outdoor use.

C. Tape and Stencil: 4-inch- wide black stripes on 10-inch centers placed diagonally over orange background and is 12 inches wide. Stop stripes at legends.

D. Floor Marking Tape: 2-inch- wide, 5-mil pressure-sensitive vinyl tape, with yellow and black stripes and clear vinyl overlay.

E. Underground-Line Warning Tape:

1. Tape:

a. Recommended by manufacturer for the method of installation and suitable to identify and locate underground electrical and communications lines.
b. Printing on tape shall be permanent and shall not be damaged by burial operations.
c. Tape material and ink shall be chemically inert and not subject to degradation when exposed to acids, alkalis, and other destructive substances commonly found in soils.

2. Color and Printing:

a. Comply with ANSI Z535.1, ANSI Z535.2, ANSI Z535.3, ANSI Z535.4, and ANSI Z535.5.
b. Inscriptions for Red-Colored Tapes: "ELECTRIC LINE, HIGH VOLTAGE"
c. Inscriptions for Orange-Colored Tapes: "TELEPHONE CABLE, CATV CABLE, COMMUNICATIONS CABLE, OPTICAL FIBER CABLE".

3. Description:

a. Detectable three-layer laminate, consisting of a printed pigmented polyolefin film, a solid aluminum-foil core, and a clear protective film that allows inspection of the continuity of the conductive core; bright colored, compounded for direct-burial service.
b. Width: 3 inches.
c. Overall Thickness: 5 mils.
d. Foil Core Thickness: 0.35 mil.
e. Weight: 28 lb/1000 sq. ft.
f. Tensile according to ASTM D882: 70 lbf and 4600 psi.

F. Stenciled Legend: In nonfading, waterproof, black ink, or paint. Minimum letter height shall be 1 inch.

2.6 SIGNS

A. Baked-Enamel Signs:
1. Preprinted aluminum signs, high-intensity reflective, punched or drilled for fasteners, with colors, legend, and size required for application.
2. 1/4-inch grommets in corners for mounting.
3. Nominal Size: 7 by 10 inches.

B. Metal-Backed Butyrate Signs:
1. Weather-resistant, nonfading, preprinted, cellulose-acetate butyrate signs, with 0.0396-inch galvanized-steel backing, punched and drilled for fasteners, and with colors, legend, and size required for application.
2. 1/4-inch grommets in corners for mounting.
3. Nominal Size: 10 by 14 inches.

C. Laminated Acrylic or Melamine Plastic Signs:
1. Engraved legend.
2. Thickness:

a. For signs up to 20 sq. in., minimum 1/16 inch thick.
b. For signs larger than 20 sq. in., 1/8 inch thick.
c. Engraved legend with black letters on white face
d. Punched or drilled for mechanical fasteners with 1/4-inch grommets in corners for mounting.

e. Framed with mitered acrylic molding and arranged for attachment at applicable equipment.

2.7 CABLE TIES

A. Plenum-Rated Cable Ties: Self-extinguishing, UV stabilized, one piece, and self-locking.

1. Minimum Width: 3/16 inch (5 mm).
2. Tensile Strength at 73 Deg F (23 Deg C) according to ASTM D638: 7000 psi (48.2 MPa).
3. UL 94 Flame Rating: 94V-0.
4. Temperature Range: Minus 50 to plus 284 deg F (Minus 46 to plus 140 deg C).
5. Color: Black.

2.8 MISCELLANEOUS IDENTIFICATION PRODUCTS

A. Paint: Comply with requirements in painting Sections for paint materials and application requirements. Retain paint system applicable for surface material and location (exterior or interior).

B. Fasteners for Labels and Signs: Self-tapping, stainless-steel screws or stainless-steel machine screws with nuts and flat and lock washers.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Equipment to Be Labeled:

a. Panelboards, electrical cabinets, and enclosures.
b. Electrical switchgear and switchboards.
c. Disconnect switches.
d. Enclosed circuit breakers.
e. Motor starters.
f. Push-button stations.
g. Power transfer equipment.
h. Contactors.

B. Verify and coordinate identification names, abbreviations, colors, and other features with requirements in other Sections requiring identification applications, Drawings, Shop Drawings, manufacturer's wiring diagrams, and operation and maintenance manual. Use consistent designations throughout Project.

C. Install identifying devices before installing acoustical ceilings and similar concealment.

D. Verify identity of each item before installing identification products.

E. Coordinate identification with Project Drawings, manufacturer's wiring diagrams, and operation and maintenance manual.

F. Apply identification devices to surfaces that require finish after completing finish work.

G. Install signs with approved legend to facilitate proper identification, operation, and maintenance of electrical systems and connected items.

H. Self-Adhesive Identification Products: Before applying electrical identification products, clean substrates of substances that could impair bond, using materials and methods recommended by manufacturer of identification product.

I. System Identification for Raceways and Cables under 600 V: Identification shall completely encircle cable or conduit. Place identification of two-color markings in contact, side by side.

1. Secure tight to surface of conductor, cable, or raceway.

J. Auxiliary Electrical Systems Conductor Identification: Identify field-installed alarm, control, and signal connections.

K. Emergency Operating Instruction Signs: Install instruction signs with white legend on a red background with minimum 3/8-inch- (10-mm-) high letters for emergency instructions at equipment used for power transfer and/or any emergency operations.

L. Elevated Components: Increase sizes of labels, signs, and letters to those appropriate for viewing from the floor.

M. Accessible Fittings for Raceways: Identify the covers of each junction and pull box of the following systems with the wiring system legend and system voltage. System legends shall be as follows:

1. "EMERGENCY POWER"
2. "POWER"
3. "UPS"
4. “LIFE SAFETY”

N. Vinyl Wraparound Labels:

1. Secure tight to surface at a location with high visibility and accessibility.
2. Attach labels that are not self-adhesive type with clear vinyl tape, with adhesive appropriate to the location and substrate.

O. Snap-around Labels: Secure tight to surface at a location with high visibility and accessibility.

P. Self-Adhesive Wraparound Labels: Secure tight to surface of raceway or cable at a location with high visibility and accessibility.

Q. Self-Adhesive Labels:

1. On each unit of equipment, install unique designation label that is consistent with wiring diagrams, schedules, and operation and maintenance manual.
2. Unless otherwise indicated, provide a single line of text with 1/2-inch- (13-mm-) high letters on 1-1/2-inch- (38-mm-) high label; where two lines of text are required, use labels 2 inches (50 mm) high.

R. Snap-around Color-Coding Bands: Secure tight to surface at a location with high visibility and accessibility.

S. Heat-Shrink, Preprinted Tubes: Secure tight to surface at a location with high visibility and accessibility.

T. Marker Tapes: Secure tight to surface at a location with high visibility and accessibility.

U. Self-Adhesive Vinyl Tape: Secure tight to surface at a location with high visibility and accessibility.

1. Field-Applied, Color-Coding Conductor Tape: Apply in half-lapped turns for a minimum distance of 6 inches (150 mm) where splices or taps are made. Apply last two turns of tape with no tension to prevent possible unwinding.

V. Tape and Stencil: Comply with requirements in painting Sections for surface preparation and paint application.

W. Floor Marking Tape: Apply stripes to finished surfaces following manufacturer's written instructions.

X. Underground Line Warning Tape:

1. During backfilling of trenches, install continuous underground-line warning tape directly above cable or raceway at 6 to 8 inches (150 to 200 mm) below finished grade. Use multiple tapes where width of multiple lines installed in a common trench or concrete envelope exceeds 16 inches (400 mm) overall.
2. Install underground-line warning tape for direct-buried cables and cables in raceways.

Y. Write-on Tags:

1. Place in a location with high visibility and accessibility.

Z. Baked-Enamel Signs:

1. Attach signs that are not self-adhesive type with mechanical fasteners appropriate to the location and substrate.
2. Unless otherwise indicated, provide a single line of text with 1/2-inch- (13-mm-) high letters on minimum 1-1/2-inch- (38-mm-) high sign; where two lines of text are required, use signs minimum 2 inches (50 mm) high.

AA. Metal-Backed Butyrate Signs:

1. Attach signs that are not self-adhesive type with mechanical fasteners appropriate to the location and substrate.
2. Unless otherwise indicated, provide a single line of text with 1/2-inch- (13-mm-) high letters on minimum 1-1/2-inch- (38-mm-) high sign; where two lines of text are required, use signs minimum 2 inches (50 mm) high.

BB. Laminated Acrylic or Melamine Plastic Signs:

1. Attach signs and plastic labels that are not self-adhesive type with mechanical fasteners appropriate to the location and substrate.
2. Unless otherwise indicated, provide a single line of text with 1/2-inch- (13-mm-) high letters on minimum 1-1/2-inch- (38-mm-) high sign; where two lines of text are required, use signs minimum 2 inches (50 mm) high.

CC. Cable Ties: General purpose, for attaching tags, except as listed below:

1. Outdoors: UV-stabilized nylon.
2. In Spaces Handling Environmental Air: Plenum rated.

3.2 IDENTIFICATION SCHEDULE

A. Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment. Install access doors or panels to provide view of identifying devices.

B. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, pull points, and locations of high visibility. Identify by system and circuit designation.

C. Accessible Raceways and Metal-Clad Cables, 600 V or Less, for Service, Feeder, and Branch Circuits, More Than 30 A and 120 V to Ground: Identify with self-adhesive raceway labels.

1. Locate identification at changes in direction, at penetrations of walls and floors, at 50-foot (15-m) maximum intervals in straight runs, and at 25-foot (7.6-m) maximum intervals in congested areas.

D. Accessible Fittings for Raceways and Cables within Buildings: Identify the covers of each junction and pull box of the following systems with self-adhesive labels containing the wiring system legend and system voltage. System legends shall be as follows:

1. "EMERGENCY POWER"
2. "POWER"
3. "UPS"
4. “LIFE SAFETY”

E. Power-Circuit Conductor Identification, 600 V or Less: For conductors in vaults, pull and junction boxes, manholes, and handholes, use self-adhesive wraparound labels to identify the phase.

1. Locate identification at changes in direction, at penetrations of walls and floors, at 50-foot (15-m) maximum intervals in straight runs, and at 25-foot (7.6-m) maximum intervals in congested areas.

F. Control-Circuit Conductor Identification: For conductors and cables in pull and junction boxes, manholes, and handholes, use write-on tags self-adhesive wraparound labels with the conductor or cable designation, origin, and destination.

G. Control-Circuit Conductor Termination Identification: For identification at terminations, provide heat-shrink preprinted tubes with the conductor designation.

H. Auxiliary Electrical Systems Conductor Identification: Self-adhesive vinyl tape that is uniform and consistent with system used by manufacturer for factory-installed connections.

1. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, and pull points. Identify by system and circuit designation.

I. Locations of Underground Lines: Underground-line warning tape for power, lighting, communication, and control wiring and optical-fiber cable.

J. Workspace Indication: Apply floor marking tape and stencil] to finished surfaces. Show working clearances in the direction of access to live parts. Workspace shall comply with NFPA 70 and 29 CFR 1926.403 unless otherwise indicated. Do not install at flush-mounted panelboards and similar equipment in finished spaces.

K. Instructional Signs: Self-adhesive labels, including the color code for grounded and ungrounded conductors.

L. Warning Labels for Indoor Cabinets, Boxes, and Enclosures for Power and Lighting: Baked-enamel warning signs.

1. Apply to exterior of door, cover, or other access.
2. For equipment with multiple power or control sources, apply to door or cover of equipment, including, but not limited to, the following:

a. Power-transfer switches.
b. Controls with external control power connections.

M. Arc Flash Warning Labeling: Self-adhesive labels.

N. Operating Instruction Signs: Laminated acrylic or melamine plastic signs.

O. Emergency Operating Instruction Signs: Laminated acrylic or melamine plastic signs with white legend on a red background with minimum 3/8-inch- (10-mm-) high letters for emergency instructions at equipment used for power transfer and other emergency operations.

P. Equipment Identification Labels:

1. Indoor Equipment: Laminated acrylic or melamine plastic sign.
2. Outdoor Equipment: Laminated acrylic or melamine sign.

END OF SECTION 26 05 53

SECTION 26 09 23 - LIGHTING CONTROL DEVICES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Switchbox-mounted occupancy sensors.
2. Conductors and Cables

B. Related Requirements:

1. Section 262726 "Wiring Devices" for wall-box dimmers, and manual light switches.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings:

1. Interconnection diagrams showing field-installed wiring.
2. Include diagrams for power, signal, and control wiring.

1.4 INFORMATIONAL SUBMITTALS

A. Sample Warranty: For manufacturer's warranties.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For each type of lighting control device to include in operation and maintenance manuals.

B. Hardware and Firmware Operational Documentation:

1. Hardware operating and upgrade manuals.

1.6 WARRANTY

A. Manufacturer's Warranty: Manufacturer and Installer agree to replace lighting control devices that fail(s) in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Faulty operation of lighting control software.
b. Faulty operation of lighting control devices.

2. Warranty Period: Two year(s) from date of Substantial Completion and consisting of a one for one device replacement.

PART 2 - PRODUCTS

2.1 SWITCHBOX-MOUNTED OCCUPANCY SENSORS

A. General Requirements for Sensors: Automatic-wall-switch occupancy sensor with manual on-off switch, suitable for mounting in a single gang switchbox using hardwired connection.

1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
2. Occupancy Sensor Operation: Unless otherwise indicated, turn lights on when coverage area is occupied, and turn lights off when unoccupied; with a time delay for turning lights off, adjustable over a minimum range of 1 to 20 minutes.
3. Operating Ambient Conditions: Dry interior conditions, 32 to 120 deg F (0 to 49 deg C).
4. Switch Rating: Not less than 1000-VA LED load at 120 V, 1200-VA LED load at 277 V.

B. Wall-Switch Sensor:

1. Standard Range: 180-degree field of view, field adjustable from 180 to 40 degrees; with a minimum coverage area of 2100 sq. ft (196 sq. m).
2. Sensing Technology: Dual technology.
3. Switch Type: SP, manual "on," automatic "off."
4. Capable of controlling load in three-way application.
5. Voltage: Dual voltage - 120 and 277 V.
6. Concealed, field-adjustable, "off" time-delay selector at up to 20 minutes.
7. Color: Coordinate color of switch and faceplate requirements with Section 262726 “Wiring Devices”.

2.2 CONDUCTORS AND CABLES

A. Power Wiring to Supply Side of Remote-Control Power Sources: Not smaller than No. 12 AWG. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

B. Classes 2 and 3 Control Cable: Multiconductor cable with stranded-copper conductors not smaller than No. 18 AWG. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

C. Class 1 Control Cable: Multiconductor cable with stranded-copper conductors not smaller than No. 14 AWG. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine lighting control devices before installation. Reject lighting control devices that are wet, moisture damaged, or mold damaged.

B. Examine walls and ceilings for suitable conditions where lighting control devices will be installed.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 WIRING INSTALLATION

A. Comply with NECA 1.

B. Wiring Method: Comply with Section 260519 "Low-Voltage Electrical Power Conductors and Cables." Minimum conduit size is 1/2 inch (13 mm) when installed in inaccessible spaces. Utilizing adjacent line voltage power conduit is acceptable providing that insulation requirements are maintained (600V). Exposed conductors in accessible spaces is acceptable when proper cabling installation techniques are utilized.

C. Wiring within Enclosures: Comply with NECA 1. Separate power-limited and nonpower-limited conductors according to conductor manufacturer's written instructions.

D. Size conductors according to lighting control device manufacturer's written instructions unless otherwise indicated.

E. Splices, Taps, and Terminations: Make connections only on numbered terminal strips in junction, pull, and outlet boxes; terminal cabinets; and equipment enclosures.

F. Provide written or computer-generated documentation on the configuration of the system including room by room description including:
   1. Sensor parameters, time delays, sensitivities, and daylighting setpoints.
   2. Sequence of operation, (e.g. manual ON, Auto OFF. etc.)
   3. Load Parameters (e.g. blink warning, etc.)

3.3 IDENTIFICATION

A. Identify components and power and control wiring according to Section 260553 "Identification for Electrical Systems."

   1. Identify circuits or luminaires controlled by photoelectric and occupancy sensors at each sensor.

3.4 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

1. Operational Test: After installing time switches and sensors, and after electrical circuitry has been energized, start units to confirm proper unit operation.
2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

B. Tests and Inspections: Manufacturer's service representative shall perform the following inspections and prepare reports.

1. Verify Class I and II wiring connections are terminated properly by validating system performance.
2. Set IP addresses and other network settings of system front end hardware per facilities IT instructions.
3. Verify / complete task programming for all switches, dimmers, time clocks, and sensors.
4. Verify that the control of each space complies with the Sequence of Operation.
5. Correct any system issues and retest.

C. Lighting control devices will be considered defective if they do not pass tests and inspections.

D. Provide a report in table format with drawings or using a software file that can be opened in the manufacturer's system software including each room or space that has lighting control installed. Indicate the following:

1. Date of test or inspection.
2. Loads per space, or Fixture Address identification.
3. Quantity and Type of each device installed
4. Reports providing each device's settings.

3.5 ADJUSTING

A. Occupancy Adjustments: When requested within 12 months from date of Substantial Completion, provide on-site assistance in adjusting lighting control devices to suit actual occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose.

1. For occupancy and motion sensors, verify operation at outer limits of detector range. Set time delay to suit Owner's operations.
2. For daylighting controls, adjust set points and deadband controls to suit Owner's operations.
3. Align high-bay occupancy sensors using manufacturer's laser aiming tool.

3.6 FIRMWARE SERVICE AGREEMENT

A. Technical Support: Beginning at Substantial Completion, service agreement shall include firmware support for two years.

B. Upgrade Service: At Substantial Completion, update firmware to latest version. Install and program firmware upgrades that become available within two years from date of Substantial Completion.

1. Upgrade Notice: At least 30 days to allow Owner to schedule and access the system and to upgrade equipment if necessary.

3.7 DEMONSTRATION

A. Before Substantial Completion, arrange and provide a one-day Owner instruction period to designated Owner personnel. Set-up, starting of the lighting control system and Owner instruction includes:

1. Confirmation of entire system operation and communication to each device.
2. Confirmation of operation of individual relays, switches, and sensors.
3. Confirmation of system Programming, override settings, etc.
4. Provide training to cover installation, programming, operation, and troubleshooting of the lighting control system.

3.8 PRODUCT SUPPORT AND SERVICE

A. Factory telephone support shall be available at no cost to the Owner following acceptance. Factory assistance shall consist of assistance in solving application issues pertaining to the control equipment.

END OF SECTION 26 09 23

SECTION 26 24 16 - PANELBOARDS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Distribution panelboards.
2. Lighting and appliance branch-circuit panelboards.

1.2 DEFINITIONS

A. MCCB: Molded-case circuit breaker.

B. SPD: Surge protective device.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of panelboard.

B. Shop Drawings: For each panelboard and related equipment.

1. Include dimensioned plans, elevations, sections, and details.
2. Detail enclosure types including mounting and anchorage, environmental protection, knockouts, corner treatments, covers and doors, gaskets, hinges, and locks.
3. Detail bus configuration, current, and voltage ratings.
4. Short-circuit current rating of panelboards and overcurrent protective devices.
5. Include evidence of NRTL listing for SPD as installed in panelboard.
6. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
7. Include wiring diagrams for power, signal, and control wiring.
8. Key interlock scheme drawing and sequence of operations.
9. Include time-current coordination curves for each type and rating of overcurrent protective device included in panelboards.

1.4 INFORMATIONAL SUBMITTALS

A. Panelboard schedules for installation in panelboards.

1.5 CLOSEOUT SUBMITTALS

A. Operation and maintenance data.

1.6 WARRANTY

A. Manufacturer's Warranty: Manufacturer agrees to repair or replace panelboards that fail in materials or workmanship within specified warranty period.

1. Panelboard Warranty Period: 18 months from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PANELBOARDS COMMON REQUIREMENTS

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Comply with NEMA PB 1.

C. Comply with NFPA 70.

D. Enclosures: Flush and/or Surface-mounted, as indicated on Drawings, dead-front cabinets.

1. Rated for environmental conditions at installed location.
   a. Indoor Dry and Clean Locations: NEMA 250, Type 1.
   b. Outdoor Locations: NEMA 250, Type 3R.
   c. Kitchen and Wash-Down Areas: NEMA 250, Type 4X, stainless steel.
   d. Wet or Damp Indoor Locations: NEMA 250, Type 4.
   e. Indoor Locations Subject to Dust, Falling Dirt, and Dripping Noncorrosive Liquids: NEMA 250, Type 12.
2. Height: 84 inches (2.13 m) maximum.
3. Hinged Front Cover: Entire front trim hinged to box and with standard door within hinged trim cover. Trims shall cover all live parts and shall have no exposed hardware.

E. Phase, Neutral, and Ground Buses: Tin-plated aluminum.

F. Conductor Connectors: Suitable for use with conductor material and sizes.

1. Material: Tin-plated aluminum.
2. Main and Neutral Lugs: Mechanical type, with a lug on the neutral bar for each pole in the panelboard.
3. Ground Lugs and Bus-Configured Terminators: Mechanical type, with a lug on the bar for each pole in the panelboard.
4. Feed-Through Lugs: Mechanical type, suitable for use with conductor material. Locate at opposite end of bus from incoming lugs or main device.
5. Subfeed (Double) Lugs: Mechanical type suitable for use with conductor material. Locate at same end of bus as incoming lugs or main device.

G. NRTL Label: Panelboards shall be labeled by an NRTL acceptable to authority having jurisdiction for use as service equipment with one or more main service disconnecting and overcurrent protective devices.

H. Future Devices: Panelboards shall have mounting brackets, bus connections, filler plates, and necessary appurtenances required for future installation of devices.

I. Panelboard Short-Circuit Current Rating: Fully rated to interrupt symmetrical short-circuit current available at terminals. Assembly listed by an NRTL for 100 percent interrupting capacity.

2.2 PERFORMANCE REQUIREMENTS

A. Surge Suppression: Factory installed as an integral part of indicated panelboards, complying with UL 1449 SPD Type 1 or Type 2.

2.3 POWER PANELBOARDS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Square D, a division of Schneider Electric
2. G.E., a division of ABB
3. Siemens Energy & Automation, Inc.
4. Eaton Corporation, Cutler-Hammer Products

B. Panelboards: NEMA PB 1, distribution type.

C. Doors: Secured with vault-type latch with tumbler lock; keyed alike.

1. For doors more than 36 inches (914 mm) high, provide two latches, keyed alike.

D. Branch Overcurrent Protective Devices for Circuit-Breaker Frame Sizes 125 A and Smaller: Bolt-on circuit breakers.

E. Branch Overcurrent Protective Devices for Circuit-Breaker Frame Sizes Larger Than 125 A: Bolt-on circuit breakers.

2.4 LIGHTING AND APPLIANCE BRANCH-CIRCUIT PANELBOARDS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Square D, a division of Schneider Electric
2. G.E., a division of ABB
3. Siemens Energy & Automation, Inc.
4. Eaton Corporation, Cutler-Hammer Products

B. Panelboards: NEMA PB 1, lighting and appliance branch-circuit type.

C. Branch Overcurrent Protective Devices: Bolt-on circuit breakers, replaceable without disturbing adjacent units.

D. Doors: Concealed hinges; secured with flush latch with tumbler lock; keyed alike.

2.5 DISCONNECTING AND OVERCURRENT PROTECTIVE DEVICES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Square D, a division of Schneider Electric
2. G.E., a division of ABB
3. Siemens Energy & Automation, Inc.
4. Eaton Corporation, Cutler-Hammer Products

B. MCCB: Comply with UL 489, with interrupting capacity to meet available fault currents.

1. Thermal-Magnetic Circuit Breakers:
   a. Inverse time-current element for low-level overloads.
   b. Instantaneous magnetic trip element for short circuits.
   c. Adjustable magnetic trip setting for circuit-breaker frame sizes 200 A and larger.
2. Adjustable Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.
3. Electronic Trip Circuit Breakers:
   a. RMS sensing.
   b. Field-replaceable rating plug or electronic trip.
   c. Digital display of settings, trip targets, and indicated metering displays.
   d. Multi-button keypad to access programmable functions and monitored data.
   e. Ten-event, trip-history log. Each trip event shall be recorded with type, phase, and magnitude of fault that caused the trip.
   f. Integral test jack for connection to portable test set or laptop computer.
   g. Field-Adjustable Settings:
      1) Instantaneous trip.
      2) Long- and short-time pickup levels.
      3) Long and short time adjustments.
      4) Ground-fault pickup level, time delay, and I squared T response.
4. Current-Limiting Circuit Breakers: Frame sizes 400 A and smaller; let-through ratings less than NEMA FU 1, RK-5.
5. GFCI Circuit Breakers: Single- and double-pole configurations with Class A ground-fault protection (6-mA trip).
6. GFEP Circuit Breakers: Class B ground-fault protection (30-mA trip).
7. Arc-Fault Circuit Interrupter Circuit Breakers: Comply with UL 1699; 120/240-V, single-pole configuration.
8. Subfeed Circuit Breakers: Vertically mounted.
9. MCCB Features and Accessories:
   a. Standard frame sizes, trip ratings, and number of poles.
   b. Breaker handle indicates tripped status.
   c. UL listed for reverse connection without restrictive line or load ratings.
   d. Lugs: Mechanical style, suitable for number, size, trip ratings, and conductor materials.
   e. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and HID lighting circuits.
   f. Ground-Fault Protection: Integrally mounted relay and trip unit with adjustable pickup and time-delay settings, push-to-test feature, and ground-fault indicator.
   g. Shunt Trip: 120-V trip coil energized from separate circuit, set to trip at 55 percent of rated voltage.

2.6 IDENTIFICATION

A. Panelboard Label: Manufacturer's name and trademark, voltage, amperage, number of phases, and number of poles shall be located on the interior of the panelboard door.

B. Breaker Labels: Faceplate shall list current rating, UL and IEC certification standards, and AIC rating.

C. Circuit Directory: Directory card inside panelboard door, mounted in transparent card holder.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Comply with NECA 1.

B. Install panelboards and accessories according to NECA 407.

C. Mount panels at height above finished floor so that no operating handle of switch or circuit breaker in the on position is higher than 79 inches (2000 mm).

D. Mount panelboard cabinet plumb and rigid without distortion of box.

E. Mount recessed panelboards with fronts uniformly flush with wall finish and mating with back box.

F. Install overcurrent protective devices and controllers not already factory installed.
   1. Set field-adjustable, circuit-breaker trip ranges.

G. Make grounding connections and bond neutral for services and separately derived systems to ground. Make connections to grounding electrodes, separate grounds for isolated ground bars, and connections to separate ground bars.

H. Install filler plates in unused spaces.

I. Stub four 1-inch (27-EMT) empty conduits from panelboard into accessible ceiling space if so constructed or space designated to be ceiling space in the future. Stub four 1-inch (27-EMT) empty conduits into raised floor space or below slab not on grade.

J. Arrange conductors in gutters into groups and bundle and wrap with wire ties.

3.2 IDENTIFICATION

A. Identify field-installed conductors, interconnecting wiring, and components; install warning signs complying with requirements in "Identification for Electrical Systems."

B. Create a directory to indicate installed circuit loads; incorporate Owner's final room designations. Obtain approval before installing. Handwritten directories are not acceptable. Install directory inside panelboard door.

C. Panelboard Nameplates: Label each panelboard with a nameplate complying with requirements for identification specified in "Identification for Electrical Systems."

D. Device Nameplates: Label each branch circuit device in power panelboards with a nameplate complying with requirements for identification specified in "Identification for Electrical Systems."

E. Install warning signs complying with requirements in "Identification for Electrical Systems" identifying source of remote circuit.

3.3 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Acceptance Testing Preparation:

1. Test insulation resistance for each panelboard bus, component, connecting supply, feeder, and control circuit.
2. Test continuity of each circuit.

C. Tests and Inspections:

1. Perform each visual and mechanical inspection and electrical test for low-voltage air circuit breakers stated in NETA ATS. Certify compliance with test parameters.
2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.

D. Panelboards will be considered defective if they do not pass tests and inspections.

E. Prepare test and inspection reports, including a certified report that identifies panelboards included and that describes scanning results, with comparisons of the two scans. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

END OF SECTION 26 24 16

SECTION 26 27 26 - WIRING DEVICES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Standard-grade receptacles, 125 V, 20 A.
2. USB receptacles.
3. GFCI receptacles, 125 V, 20 A.
4. SPD receptacles, 125 V, 20 A.
5. Twist-locking receptacles.
6. Toggle switches.
7. Wall-box dimmers.
8. Wall plates.
9. Floor service fittings.

1.3 DEFINITIONS

A. BAS: Building automation system.

B. EMI: Electromagnetic interference.

C. GFCI: Ground-fault circuit interrupter.

D. Pigtail: Short lead used to connect a device to a branch-circuit conductor.

E. RFI: Radio-frequency interference.

F. SPD: Surge protective device.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: List of legends and description of materials and process used for premarking wall plates.

C. Samples: One for each type of device and wall plate specified, in each color specified.

1.5 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For wiring devices to include in all manufacturers' packing-label warnings and instruction manuals that include labeling conditions.

1.7 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Poke-Through, Fire-Rated Closure Plugs: One for every five floor service outlets installed, but no fewer than two.
2. SPD Receptacles: One for every 10 of each type installed, but no fewer than one of each type.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Subject to compliance with requirements, provide products by one of the following:

B. Wiring Devices:

1. Bryant Electric, Inc., Hubbell Subsidiary.
2. Eagle Electric Manufacturing Co.
3. Hubbell Incorporated; Wiring Device-Kellems.
4. Leviton Mfg Company
5. Pass & Seymour/Legrand; Wiring Devices Div.

2.2 GENERAL WIRING-DEVICE REQUIREMENTS

A. Wiring Devices, Components, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.

B. Comply with NFPA 70.

C. RoHS compliant.

D. Comply with NEMA WD 1.

E. Device Color:

1. Wiring Devices Connected to Normal Power System: As selected by Architect unless otherwise indicated or required by NFPA 70 or device listing.
2. SPD Devices: Blue.

F. Wall Plate Color: For plastic covers, match device color.

G. Source Limitations: Obtain each type of wiring device and associated wall plate from single source from single manufacturer.

2.3 STANDARD-GRADE RECEPTACLES, 125 V, 20 A

A. Duplex Receptacles, 125 V, 20 A:

1. Description: Two pole, three wire, and self-grounding.
2. Configuration: NEMA WD 6, Configuration 5-20R.
3. Standards: Comply with UL 498 and FS W-C-596.

2.4 USB RECEPTACLES

A. USB Charging Receptacles:

1. Description: Single piece, rivetless, nickel-plated, all-brass grounding system. Nickel-plated, brass mounting strap.
2. USB Receptacles: Dual, USB Type A and Type-C, 5 V dc, and 2.4 A per receptacle (minimum).
3. Standards: Comply with UL 1310 and USB 3.0 devices.

2.5 GFCI RECEPTACLES, 125 V, 20 A

A. Duplex GFCI Receptacles, 125 V, 20 A:

1. Description: Integral GFCI with "Test" and "Reset" buttons and LED indicator light. Two pole, three wire, and self-grounding.
2. Configuration: NEMA WD 6, Configuration 5-20R.
3. Type: Non-feed through.
4. Standards: Comply with UL 498, UL 943 Class A, and FS W-C-596.

B. Weather-Resistant, GFCI Duplex Receptacles, 125 V, 20 A:

1. Description: Integral GFCI with "Test" and "Reset" buttons and LED indicator light. Two pole, three wire, and self-grounding.
2. Configuration: NEMA WD 6, Configuration 5-20R.
3. Type: Non-feed through.
4. Standards: Comply with UL 498 and UL 943 Class A.
5. Marking: Listed and labeled as complying with NFPA 70, "Receptacles in Damp or Wet Locations" article.

2.6 SPD RECEPTACLES, 125 V, 20 A

A. Duplex SPD Receptacles, 125 V, 20 A:

1. Description: Two pole, three wire, and self-grounding. Integral SPD in line to ground, line to neutral, and neutral to ground. LED indicator light.

2. SPD Components: Multiple metal-oxide varistors; with a nominal clamp-level rating of 400 V and minimum single transient pulse energy dissipation of 240 J, according to IEEE C62.41.2 and IEEE C62.45.
3. Active SPD Indication: Visual and audible, with light visible in face of device to indicate device is "active" or "no longer in service."
4. Configuration: NEMA WD 6, Configuration 5-20R.
5. Standards: Comply with NEMA WD 1, UL 498, UL 1449, and FS W-C-596.

2.7 TWIST-LOCKING RECEPTACLES

A. Twist-Lock, Single Receptacles, 250 V, 20 A,30A, 50A, and 60A (as indicated on drawings):

1. Configuration: As indicated on drawings or to match equipment plug.
2. Standards: Comply with UL 498.

2.8 TOGGLE SWITCHES, 120/277 V, 20 A

A. Two-Pole Switches, 120/277 V, 20 A: Comply with UL 20 and FS W-S-896.

B. Three-Way Switches, 120/277 V, 20 A: Comply with UL 20 and FS W-S-896.

C. Four-Way Switches, 120/277 V, 20 A: Standards: Comply with UL 20 and FS W-S-896.

D. Lighted Single-Pole Switches, 120/277 V, 20 A:

1. Description: Handle illuminated when switch is off.
2. Standards: Comply with NEMA WD 1, UL 20, and FS W-S-896.

2.9 DIMMERS

A. Wall-Box Dimmers:

1. <Double click here to find, evaluate, and insert list of manufacturers and products.>
2. Description: Modular, full-wave, solid-state dimmer switch with integral, quiet on-off switches, with audible frequency and EMI/RFI suppression filters.
3. Control: Continuously adjustable slider; with single-pole or three-way switching.
4. Standards: Comply with UL 1472.
5. Retain "Incandescent Lamp Dimmers," "Fluorescent Lamp Dimmer Switches," or "LED Lamp Dimmer Switches" Subparagraph below. Coordinate dimmer type with lamp type.

6. Incandescent Lamp Dimmers: 120 V; control shall follow square-law dimming curve. On-off switch positions shall bypass dimmer module, dimmers shall require no derating when ganged with other devices.
7. LED Lamp Dimmer Switches: Modular; compatible with LED lamps; trim potentiometer to adjust low-end dimming; capable of consistent dimming with low end not greater than 5 percent of full brightness.

2.10 WALL PLATES

A. Single Source: Obtain wall plates from same manufacturer of wiring devices.

B. Single and combination types shall match corresponding wiring devices.

1. Plate-Securing Screws: Metal with head color to match plate finish.
2. Material for Finished Spaces: Smooth, high-impact thermoplastic 0.035-inch- (1-mm-) thick, satin-finished.
3. Material for Unfinished Spaces: Galvanized steel.
4. Material for Damp Locations: Cast aluminum with spring-loaded lift cover, and listed and labeled for use in wet and damp locations.

C. Wet-Location, Weatherproof Cover Plates: NEMA 250, complying with Type 3R, weather-resistant, thermoplastic with lockable while in-use cover.

2.11 FLOOR SERVICE FITTINGS

A. Above-Floor Service Fittings:

1. Description: Type: Modular, above-floor, dual-service units suitable for wiring method used.
2. Service Plate: Rectangular satin finish.
3. Power Receptacle: NEMA WD 6 Configuration 5-20R, gray finish, unless otherwise indicated.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Comply with NECA 1, including mounting heights listed in that standard, unless otherwise indicated.

B. Coordination with Other Trades:

1. Protect installed devices and their boxes. Do not place wall finish materials over device boxes, and do not cut holes for boxes with routers that are guided by riding against outside of boxes.
2. Keep outlet boxes free of plaster, drywall joint compound, mortar, cement, concrete, dust, paint, and other material that may contaminate the raceway system, conductors, and cables.
3. Install device boxes in brick or block walls so that the cover plate does not cross a joint unless the joint is troweled flush with the face of the wall.
4. Install wiring devices after all wall preparation, including painting, is complete.

C. Conductors:

1. Do not strip insulation from conductors until right before they are spliced or terminated on devices.
2. Strip insulation evenly around the conductor using tools designed for the purpose. Avoid scoring or nicking of solid wire or cutting strands from stranded wire.
3. The length of free conductors at outlets for devices shall comply with NFPA 70, Article 300, without pigtails.
4. Existing Conductors:
   a. Cut back and pigtail or replace all damaged conductors.
   b. Straighten conductors that remain and remove corrosion and foreign matter.

c. Pigtailing existing conductors is permitted, provided the outlet box is large enough.

D. Device Installation:

1. Replace devices that have been in temporary use during construction and that were installed before building finishing operations were complete.
2. Keep each wiring device in its package or otherwise protected until it is time to connect conductors.
3. Do not remove surface protection, such as plastic film and smudge covers, until the last possible moment.
4. Connect devices to branch circuits using pigtails that are not less than 6 inches (152 mm) in length.
5. When there is a choice, use side wiring with binding-head screw terminals. Wrap solid conductor tightly clockwise, two-thirds to three-fourths of the way around terminal screw.
6. Use a torque screwdriver when a torque is recommended or required by manufacturer.
7. When conductors larger than No. 12 AWG are installed on 15- or 20-A circuits, splice No. 12 AWG pigtails for device connections.
8. Tighten unused terminal screws on the device.
9. When mounting into metal boxes, remove the fiber or plastic washers used to hold device-mounting screws in yokes, allowing metal-to-metal contact.

E. Receptacle Orientation:

1. Install ground pin of vertically mounted receptacles down, and on horizontally mounted receptacles to the right.

F. Device Plates: Do not use oversized or extra-deep plates. Repair wall finishes and remount outlet boxes when standard device plates do not fit flush or do not cover rough wall opening.

G. Dimmers:

1. Install dimmers within terms of their listing.
2. Verify that dimmers used for fan-speed control are listed for that application.
3. Install unshared neutral conductors on line and load side of dimmers according to manufacturers' device, listing conditions in the written instructions.

H. Arrangement of Devices: Unless otherwise indicated, mount flush, with long dimension vertical and with grounding terminal of receptacles on bottom. Group adjacent switches under single, multigang wall plates.

3.2 GFCI RECEPTACLES

A. Install non-feed-through GFCI receptacles where protection of downstream receptacles is not required.

3.3 IDENTIFICATION

A. Comply with Section 260553 "Identification for Electrical Systems."

B. Identify each receptacle with panelboard identification and circuit number. Use hot, stamped, or engraved machine printing with black-filled lettering on face of plate, and durable wire markers or tags inside outlet boxes.

3.4 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:

1. In healthcare facilities, prepare reports that comply with NFPA 99.
2. Test Instruments: Use instruments that comply with UL 1436.
3. Test Instrument for Receptacles: Digital wiring analyzer with digital readout or illuminated digital-display indicators of measurement.

B. Tests for Receptacles:

1. Line Voltage: Acceptable range is 105 to 132 V.
2. Percent Voltage Drop under 15-A Load: A value of 6 percent or higher is unacceptable.
3. Ground Impedance: Values of up to 2 ohms are acceptable.
4. GFCI Trip: Test for tripping values specified in UL 1436 and UL 943.
5. Using the test plug, verify that the device and its outlet box are securely mounted.

C. Wiring device will be considered defective if it does not pass tests and inspections.

D. Prepare test and inspection reports.

END OF SECTION 26 27 26

SECTION 26 28 16 - ENCLOSED SWITCHES AND CIRCUIT BREAKERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Nonfusible switches.
2. Shunt trip switches.
3. Enclosures.

1.2 DEFINITIONS

A. NC: Normally closed.

B. NO: Normally open.

C. SPDT: Single pole, double throw.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of enclosed switch, circuit breaker, accessory, and component indicated. Include nameplate ratings, dimensioned elevations, sections, weights, and manufacturers' technical data on features, performance, electrical characteristics, ratings, accessories, and finishes.

1. Enclosure types and details for types other than NEMA 250, Type 1.
2. Current and voltage ratings.
3. Short-circuit current ratings (interrupting and withstand, as appropriate).
4. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices, accessories, and auxiliary components.
5. Include time-current coordination curves (average melt) for each type and rating of overcurrent protective device; include selectable ranges for each type of overcurrent protective device. Provide in PDF and SKM electronic format.

B. Shop Drawings: For enclosed switches and circuit breakers.

1. Include plans, elevations, sections, details, and attachments to other work.
2. Include wiring diagrams for power, signal, and control wiring.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified testing agency.

B. Field quality-control reports.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For enclosed switches and circuit breakers to include in emergency, operation, and maintenance manuals.

1. Include the following:

a. Manufacturer's written instructions for testing and adjusting enclosed switches and circuit breakers.
b. Time-current coordination curves (average melt) for each type and rating of overcurrent protective device; include selectable ranges for each type of overcurrent protective device. Provide in PDF and SKM format electronic format.

1.6 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1.7 QUALITY ASSURANCE

A. Testing Agency Qualifications: Accredited by NETA.

1. Testing Agency's Field Supervisor: Currently certified by NETA to supervise on-site testing.

1.8 FIELD CONDITIONS

A. Environmental Limitations: Rate equipment for continuous operation under the following conditions unless otherwise indicated:

1. Ambient Temperature: Not less than minus 22 deg F (minus 30 deg C) and not exceeding 104 deg F (40 deg C).
2. Altitude: Not exceeding 6600 feet (2010 m).

1.9 WARRANTY

A. Manufacturer's Warranty: Manufacturer and Installer agree to repair or replace components that fail in materials or workmanship within specified warranty period.

1. Warranty Period: One year(s) from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS

A. Source Limitations: Obtain enclosed switches and circuit breakers, overcurrent protective devices, components, and accessories, within same product category, from single manufacturer.

B. Product Selection for Restricted Space: Drawings indicate maximum dimensions for enclosed switches and circuit breakers, including clearances between enclosures, and adjacent surfaces and other items. Comply with indicated maximum dimensions.

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by an NRTL, and marked for intended location and application.

D. Comply with NFPA 70.

2.2 MANUFACTURERS

A. Subject to compliance with requirements, provide products by one of the following:

1. Square D, a division of Schneider Electric
2. G.E., a division of ABB
3. Siemens Energy & Automation, Inc.
4. Eaton Corporation, Cutler-Hammer Products

2.3 NONFUSIBLE SWITCHES

A. Type GD, General Duty, Three Pole, Single Throw, 240-V ac, 600 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, lockable handle with capability to accept two padlocks, and interlocked with cover in closed position.

B. Accessories:

1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.
2. Neutral Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.
3. Isolated Ground Kit: Internally mounted; insulated, labeled for copper and aluminum neutral conductors.
4. Hookstick Handle: Allows use of a hookstick to operate the handle.
5. Lugs: Mechanical type, suitable for number, size, and conductor material.
6. Service-Rated Switches: Labeled for use as service equipment.

2.4 MOLDED-CASE CIRCUIT BREAKERS

A. Circuit breakers shall be constructed using glass-reinforced insulating material. Current carrying components shall be completely isolated from the handle and the accessory mounting area.

B. Circuit breakers shall have a toggle operating mechanism with common tripping of all poles, which provides quick-make, quick-break contact action. The circuit-breaker handle shall be over center, be trip free, and reside in a tripped position between on and off to provide local trip

indication. Circuit-breaker escutcheon shall be clearly marked on and off in addition to providing international I/O markings. Equip circuit breaker with a push-to-trip button, located on the face of the circuit breaker to mechanically operate the circuit-breaker tripping mechanism for maintenance and testing purposes.

C. The maximum ampere rating and UL, IEC, or other certification standards with applicable voltage systems and corresponding interrupting ratings shall be clearly marked on face of circuit breaker. Circuit breakers shall be 100 percent rated.

D. MCCBs shall be equipped with a device for locking in the isolated position.

E. Lugs shall be suitable for 194 deg F (90 deg C) rated wire, sized according to the 167 deg F (75 deg C) temperature rating in NFPA 70.

F. Standard: Comply with UL 489 with interrupting capacity to comply with available fault currents.

G. Thermal-Magnetic Circuit Breakers: Inverse time-current thermal element for low-level overloads and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.

H. Adjustable, Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.

I. Electronic Trip Circuit Breakers: Field-replaceable rating plug, rms sensing, with the following field-adjustable settings:

1. Instantaneous trip.
2. Long- and short-time pickup levels.
3. Long- and short-time time adjustments.
4. Ground-fault pickup level, time delay, and I-squared t response.

J. Current-Limiting Circuit Breakers: Frame sizes 400 A and smaller, and let-through ratings less than NEMA FU 1, RK-5.

K. Integrally Fused Circuit Breakers: Thermal-magnetic trip element with integral limiter-style fuse listed for use with circuit breaker and trip activation on fuse opening or on opening of fuse compartment door.

L. Ground-Fault Circuit-Interrupter (GFCI) Circuit Breakers: Single- and two-pole configurations with Class A ground-fault protection (6-mA trip).

M. Ground-Fault Equipment-Protection (GFEP) Circuit Breakers: With Class B ground-fault protection (30-mA trip).

N. Features and Accessories:

1. Standard frame sizes, trip ratings, and number of poles.
2. Lugs: Mechanical type, suitable for number, size, trip ratings, and conductor material.
3. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and high-intensity discharge lighting circuits.
4. Ground-Fault Protection: Comply with UL 1053; integrally mounted, self-powered type with mechanical ground-fault indicator; relay with adjustable pickup and time-delay

settings, push-to-test feature, internal memory, and shunt trip unit; and three-phase, zero-sequence current transformer/sensor.

5. Shunt Trip: Trip coil energized from separate circuit, with coil-clearing contact.
6. Undervoltage Trip: Set to operate at 35 to 75 percent of rated voltage without intentional time delay.
7. Zone-Selective Interlocking: Integral with ground-fault trip unit; for interlocking ground-fault protection function.
8. Accessory Control Power Voltage: Integrally mounted, self-powered.

2.5 ENCLOSURES

A. Enclosed Switches and Circuit Breakers: UL 489, NEMA KS 1, NEMA 250, and UL 50, to comply with environmental conditions at installed location.

B. Enclosure Finish: The enclosure shall be finished with gray baked enamel paint, electrodeposited on cleaned, phosphatized steel (NEMA 250 Type 1), gray baked enamel paint, electrodeposited on cleaned, phosphatized galvannealed steel (NEMA 250 Types 3R, 12), or a brush finish on Type 304 stainless steel (NEMA 250 Type 4-4X stainless steel).

C. Conduit Entry: NEMA 250 Types 4, 4X, and 12 enclosures shall contain no knockouts. NEMA 250 Types 7 and 9 enclosures shall be provided with threaded conduit openings in both endwalls.

D. Operating Mechanism: The circuit-breaker operating handle shall be directly operable through the front cover of the enclosure (NEMA 250 Type 1), directly operable through the dead front trim of the enclosure (NEMA 250 Type 3R). The cover interlock mechanism shall have an externally operated override. The override shall not permanently disable the interlock mechanism, which shall return to the locked position once the override is released. The tool used to override the cover interlock mechanism shall not be required to enter the enclosure in order to override the interlock.

E. Enclosures designated as NEMA 250 Type 4, 4X stainless steel, 12, or 12K shall have a dual cover interlock mechanism to prevent unintentional opening of the enclosure cover when the circuit breaker is ON and to prevent turning the circuit breaker ON when the enclosure cover is open.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine elements and surfaces to receive enclosed switches and circuit breakers for compliance with installation tolerances and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

1. Commencement of work shall indicate Installer's acceptance of the areas and conditions as satisfactory.

3.2 PREPARATION

A. Interruption of Existing Electric Service: Do not interrupt electric service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electric service according to requirements indicated:

1. See SECTION 260500 “ELECTRICAL GENERAL REQUIREMENTS” for direction on scheduled interruptions.
2. Indicate method of providing temporary electric service.
3. Comply with NFPA 70E.

3.3 ENCLOSURE ENVIRONMENTAL RATING APPLICATIONS

A. Enclosed Switches and Circuit Breakers: Provide enclosures at installed locations with the following environmental ratings.

1. Indoor, Dry and Clean Locations: NEMA 250, Type 1.
2. Outdoor Locations: NEMA 250, Type 3R>.
3. Kitchen or Wash-Down Areas: NEMA 250, Type 4X stainless steel.
4. Other Wet or Damp, Indoor Locations: NEMA 250, Type 4.
5. Indoor Locations Subject to Dust, Falling Dirt, and Dripping Noncorrosive Liquids: NEMA 250, Type 12.

3.4 INSTALLATION

A. Coordinate layout and installation of switches, circuit breakers, and components with equipment served and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

B. Install individual wall-mounted switches and circuit breakers with tops at uniform height unless otherwise indicated.

C. Temporary Lifting Provisions: Remove temporary lifting of eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.

D. Install fuses in fusible devices.

E. Comply with NFPA 70 and NECA 1.

3.5 IDENTIFICATION

A. Comply with requirements in Section 260553 "Identification for Electrical Systems."

1. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs.
2. Label each enclosure with engraved metal or laminated-plastic nameplate.

3.6 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Perform tests and inspections.

C. Tests and Inspections for Switches:

1. Visual and Mechanical Inspection:

a. Inspect physical and mechanical condition.
b. Inspect anchorage, alignment, grounding, and clearances.
c. Verify that the unit is clean.
d. Verify blade alignment, blade penetration, travel stops, and mechanical operation.
e. Verify that fuse sizes and types match the Specifications and Drawings.
f. Verify that each fuse has adequate mechanical support and contact integrity.
g. Inspect bolted electrical connections for high resistance using one of the two following methods:

1) Use a low-resistance ohmmeter.

a) Compare bolted connection resistance values to values of similar connections. Investigate values that deviate from those of similar bolted connections by more than 50 percent of the lowest value.

2) Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method in accordance with manufacturer's published data or NETA ATS Table 100.12.

a) Bolt-torque levels shall be in accordance with manufacturer's published data. In the absence of manufacturer's published data, use NETA ATS Table 100.12.

h. Verify that operation and sequencing of interlocking systems is as described in the Specifications and shown on the Drawings.
i. Verify correct phase barrier installation.
j. Verify lubrication of moving current-carrying parts and moving and sliding surfaces.

2. Electrical Tests:

a. Perform resistance measurements through bolted connections with a low-resistance ohmmeter. Compare bolted connection resistance values to values of similar connections. Investigate values that deviate from adjacent poles or similar switches by more than 50 percent of the lowest value.
b. Measure contact resistance across each switchblade fuseholder. Drop values shall not exceed the high level of the manufacturer's published data. If manufacturer's published data are not available, investigate values that deviate from adjacent poles or similar switches by more than 50 percent of the lowest value.
c. Perform insulation-resistance tests for one minute on each pole, phase-to-phase and phase-to-ground with switch closed, and across each open pole. Apply voltage in accordance with manufacturer's published data. In the absence of manufacturer's published data, use Table 100.1 from the NETA ATS. Investigate values of insulation resistance less than those published in Table 100.1 or as recommended in manufacturer's published data.
d. Measure fuse resistance. Investigate fuse-resistance values that deviate from each other by more than 15 percent.
e. Perform ground fault test according to NETA ATS 7.14 "Ground Fault Protection Systems, Low-Voltage."

D. Tests and Inspections for Molded Case Circuit Breakers:

1. Visual and Mechanical Inspection:

a. Verify that equipment nameplate data are as described in the Specifications and shown on the Drawings.
b. Inspect physical and mechanical condition.
c. Inspect anchorage, alignment, grounding, and clearances.
d. Verify that the unit is clean.
e. Operate the circuit breaker to ensure smooth operation.
f. Inspect bolted electrical connections for high resistance using one of the two following methods:

1) Use a low-resistance ohmmeter.

a) Compare bolted connection resistance values to values of similar connections. Investigate values that deviate from those of similar bolted connections by more than 50 percent of the lowest value.

2) Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method in accordance with manufacturer's published data or NETA ATS Table 100.12.

a) Bolt-torque levels shall be in accordance with manufacturer's published data. In the absence of manufacturer's published data, use NETA ATS Table 100.12.

g. Inspect operating mechanism, contacts, and chutes in unsealed units.
h. Perform adjustments for final protective device settings in accordance with the coordination study.

2. Electrical Tests:

a. Perform resistance measurements through bolted connections with a low-resistance ohmmeter. Compare bolted connection resistance values to values of similar connections. Investigate values that deviate from adjacent poles or similar switches by more than 50 percent of the lowest value.
b. Perform insulation-resistance tests for one minute on each pole, phase-to-phase and phase-to-ground with circuit breaker closed, and across each open pole. Apply voltage in accordance with manufacturer's published data. In the absence of manufacturer's published data, use Table 100.1 from the NETA ATS. Investigate values of insulation resistance less than those published in Table 100.1 or as recommended in manufacturer's published data.
c. Perform a contact/pole resistance test. Drop values shall not exceed the high level of the manufacturer's published data. If manufacturer's published data are not available, investigate values that deviate from adjacent poles or similar switches by more than 50 percent of the lowest value.
d. Perform insulation resistance tests on all control wiring with respect to ground. Applied potential shall be 500-V dc for 300-V rated cable and 1000-V dc for 600-V rated cable. Test duration shall be one minute. For units with solid state components, follow manufacturer's recommendation. Insulation resistance values shall be no less than two megohms.
e. Determine the following by primary current injection:

1) Long-time pickup and delay. Pickup values shall be as specified. Trip characteristics shall not exceed manufacturer's published time-current characteristic tolerance band, including adjustment factors.
2) Short-time pickup and delay. Short-time pickup values shall be as specified. Trip characteristics shall not exceed manufacturer's published time-current characteristic tolerance band, including adjustment factors.
3) Ground-fault pickup and time delay. Ground-fault pickup values shall be as specified. Trip characteristics shall not exceed manufacturer's published time-current characteristic tolerance band, including adjustment factors.
4) Instantaneous pickup. Instantaneous pickup values shall be as specified and within manufacturer's published tolerances.

f. Test functionality of the trip unit by means of primary current injection. Pickup values and trip characteristics shall be as specified and within manufacturer's published tolerances.
g. Perform minimum pickup voltage tests on shunt trip and close coils in accordance with manufacturer's published data. Minimum pickup voltage of the shunt trip and close coils shall be as indicated by manufacturer.
h. Verify correct operation of auxiliary features such as trip and pickup indicators; zone interlocking; electrical close and trip operation; trip-free, anti-pump function; and trip unit battery condition. Reset all trip logs and indicators. Investigate units that do not function as designed.
i. Verify operation of charging mechanism. Investigate units that do not function as designed.

3. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
4. Perform the following infrared scan tests and inspections and prepare reports:

a. Initial Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each enclosed switch and circuit breaker. Remove front panels so joints and connections are accessible to portable scanner.
b. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each enclosed switch and circuit breaker 11 months after date of Substantial Completion.
c. Instruments and Equipment: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.

5. Test and adjust controls, remote monitoring, and safeties. Replace damaged and malfunctioning controls and equipment.

E. Enclosed switches and circuit breakers will be considered defective if they do not pass tests and inspections.

F. Prepare test and inspection reports.

1. Test procedures used.
2. Include identification of each enclosed switch and circuit breaker tested and describe test results.
3. List deficiencies detected, remedial action taken, and observations after remedial action.

3.7 ADJUSTING

A. Adjust moving parts and operable components to function smoothly, and lubricate as recommended by manufacturer.

B. Set field-adjustable circuit-breaker trip ranges.

END OF SECTION 26 28 16

SECTION 26 43 13 - SURGE PROTECTION FOR LOW-VOLTAGE ELECTRICAL POWER CIRCUITS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes:

1. Type 1 surge protective devices.
2. Type 2 surge protective devices.
3. Enclosures.
4. Conductors and cables.

B. Related Requirements:

1. Section 262416 "Panelboards" for integral SPDs installed by panelboard manufacturer.
2. Section 262726 "Wiring Devices" for integral SPDs installed by receptacle manufacturer.

1.2 DEFINITIONS

A. Inominal: Nominal discharge current.

B. MCOV: Maximum continuous operating voltage.

C. Mode(s), also Modes of Protection: air of electrical connections where the VPR applies.

D. MOV: Metal-oxide varistor; an electronic component with a significant non-ohmic current-voltage characteristic.

E. NRTL: Nationally recognized testing laboratory.

F. OCPD: Overcurrent protective device.

G. SCCR: Short-circuit current rating.

H. SPD: Surge protective device.

I. Type 1 SPDs: Permanently connected SPDs intended for installation between the secondary of the service transformer and the line side of the service disconnect overcurrent device.

J. Type 2 SPDs: Permanently connected SPDs intended for installation on the load side of the service disconnect overcurrent device, including SPDs located at the branch panel.

K. Type 3 SPDs: Point of utilization SPDs.

L. VPR: Voltage protection rating.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include electrical characteristics, specialties, and accessories for SPDs.
2. NRTL certification of compliance with current UL 1449 edition.

a. Tested values for VPRs.
b. Inominal ratings.
c. MCOV, type designations.
d. OCPD requirements.
e. Manufacturer's model number.
f. System voltage.
g. Modes of protection.

1.4 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

B. Sample Warranty: For manufacturer's special warranty.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For SPDs to include in maintenance manuals.

1.6 WARRANTY

A. Manufacturer's Warranty: Manufacturer agrees to repair or replace SPDs that fail in materials or workmanship within five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 TYPE 2 SURGE PROTECTIVE DEVICES (SPDs)

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. APT, a division of Schneider Electric
2. SSI, an ILSCO Company
3. Siemens Energy & Automation, Inc.
4. Eaton Corporation, Cutler-Hammer Products
5. G.E., a division of ABB

B. Source Limitations: Obtain devices from single source from single manufacturer.

C. Standards:

1. Listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with UL 1449, Type 2.

2. Comply with UL 1283.

D. Product Options:

1. Include LED indicator lights for power and protection status.
2. Include internal thermal protection that disconnects the SPD before damaging internal suppressor components.
3. Include surge counter.

E. Performance Criteria:

1. MCOV: Not less than 125 percent of nominal system voltage for 208Y/120 V and 120/240 V power systems, and not less than 115 percent of nominal system voltage for 480Y/277 V power systems.
2. Peak Surge Current Rating: Minimum single-pulse surge current withstand rating per phase must not be less than 100 kA. Peak surge current rating must be arithmetic sum of the ratings of individual MOVs in a given mode.
3. Protection modes and UL 1449 VPR for grounded wye circuits with 2088Y/120 V, three-phase, four-wire circuits must not exceed the following:

    a. Line to Neutral: 700 V for 208Y/120 V.
    b. Line to Ground: 700 V for 208Y/120 V.
    c. Neutral to Ground: 700 V for 208Y/120 V.
    d. Line to Line: 1200 V for 208Y/120 V.

4. Protection modes and UL 1449 VPR for 240/120 V, single-phase, three-wire circuits must not exceed the following:

    a. Line to Neutral: 700 V.
    b. Line to Ground: 700 V.
    c. Neutral to Ground: 700 V.
    d. Line to Line: 1200 V.

5. SCCR: Equal or exceed 100 kA.
6. Inominal Rating: 20 kA.

2.2 ENCLOSURES

A. Indoor Enclosures: NEMA 250, Type 1.

B. Outdoor Enclosures: NEMA 250, Type 3R.

2.3 CONDUCTORS AND CABLES

A. Power Wiring: Same size as SPD leads, complying with Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

PART 3 - EXECUTION

3.1 INSTALLATION

A. Comply with NECA 1.

B. Provide OCPD and disconnect for installation of SPD in accordance with UL 1449 and manufacturer's written instructions.

C. Install leads between disconnects and SPDs short, straight, twisted, and in accordance with manufacturer's written instructions. Comply with wiring methods in Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

1. Do not splice and extend SPD leads unless specifically permitted by manufacturer.
2. Do not exceed manufacturer's recommended lead length.
3. Do not bond neutral and ground.

D. Use crimped connectors and splices only. Wire nuts are unacceptable.

3.2 FIELD QUALITY CONTROL

A. Perform the following tests and inspections with the assistance of a factory-authorized service representative:

1. Compare equipment nameplate data for compliance with Drawings and the Specifications.
2. Inspect anchorage, alignment, grounding, and clearances.
3. Verify that electrical wiring installation complies with manufacturer's written installation requirements.

B. SPDs that do not pass tests and inspections will be considered defective.

C. Prepare test and inspection reports.

3.3 STARTUP SERVICE

A. Complete startup checks in accordance with manufacturer's written instructions.

B. Do not perform insulation-resistance tests of the distribution wiring equipment with SPDs installed. Disconnect SPDs before conducting insulation-resistance tests; reconnect them immediately after the testing is over.

C. Energize SPDs after power system has been energized, stabilized, and tested.

3.4 DEMONSTRATION

A. Train Owner's maintenance personnel to operate and maintain SPDs.

END OF SECTION 264313

SECTION 26 51 19 - LED INTERIOR LIGHTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes interior only LED luminaires:

1.3 DEFINITIONS

A. CCT: Correlated color temperature.

B. CRI: Color Rendering Index.

C. Fixture: See "Luminaire."

D. IP: International Protection or Ingress Protection Rating.

E. LED: Light-emitting diode.

F. Lumen: Measured output of lamp and luminaire, or both.

G. Luminaire: Complete lighting unit, including lamp, reflector, and housing.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Arrange in order of luminaire designation.
2. Include data on features, accessories, and finishes.
3. Include physical description and dimensions of luminaires.
4. Include emergency lighting units, including batteries and chargers.
5. Include life, output (lumens, CCT, and CRI), and energy-efficiency data.

    a. Manufacturer's Certified Data: Photometric data certified by manufacturer's laboratory with a current accreditation under the NVLAP for Energy Efficient Lighting Products.

6. Wiring diagrams for power, control, and signal wiring.
7. Means of attaching luminaires to supports and indication that the attachment is suitable for components involved.

B. Shop Drawings: For nonstandard or custom luminaires.

1. Include plans, elevations, sections, and mounting and attachment details.
2. Include details of luminaire assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
3. Include diagrams for power, signal, and control wiring.

1.5 INFORMATIONAL SUBMITTALS

A. Sample warranty.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For luminaires and lighting systems to include in operation and maintenance manuals.

1. Provide a list of all types used on Project; use ANSI and manufacturers' codes.

1.7 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Diffusers and Lenses: One for every 100 of each type and rating installed. Furnish at least one of each type.
2. Globes and Guards: One for every 50 of each type and rating installed. Furnish at least one of each type.

1.8 QUALITY ASSURANCE

A. Each luminaire type shall be binned within a three-step MacAdam Ellipse to ensure color consistency among luminaires.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Protect finishes of exposed surfaces by applying a strippable, temporary protective covering before shipping.

1.10 WARRANTY

A. Warranty: Manufacturer and Installer agree to repair or replace components of luminaires that fail in materials or workmanship within specified warranty period.

B. Warranty Period: Two year(s) from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Ambient Temperature: 41 to 104 deg F (5 to 40 deg C).

B. Altitude: Sea level to 1000 feet (300 m).

2.2 LUMINAIRE REQUIREMENTS

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Factory-Applied Labels: Comply with UL 1598. Locate labels where they will be readily visible to service personnel, but not seen from normal viewing angles when lamps are in place.

1. Label shall include the following lamp module characteristics:

a. Manufacturer

b. Model number

c. CCT and CRI.

C. NRTL Compliance: Luminaires for hazardous locations shall be listed and labeled for indicated class and division of hazard by an NRTL.

D. FM Global Compliance: Luminaires for hazardous locations shall be listed and labeled for indicated class and division of hazard by FM Global.

E. Luminaire CRI requirements: Greater than 80 CRI unless noted otherwise on Drawings.

F. Luminaire CCT requirements: 3500K unless noted otherwise on Drawings.

G. Luminaire Lumen outputs: As indicated on Drawings or comparable with luminaire model specified on Drawings.

H. Luminaire Rated Lamp Life: As comparable with luminaire model specified on Drawings.

I. Nominal Operating Voltage: 120 V ac through 277 V ac, or as indicated on Drawings.

1. Dimmable from 100 percent to 10 percent of maximum light output.
2. Internal driver.

J. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit relamping without use of tools. Components are designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position.

K. Lens Thickness (if applicable): At least 0.125-inch (3.175-mm) minimum unless otherwise indicated.

L. Standards:

1. ENERGY STAR certified.
2. RoHS compliant.
3. Recessed luminaires shall comply with NEMA LE 4.
4. UL Listing: Listed for damp or wet location as indicated on drawings and in part numbers specified on the drawings.
5. Industrial luminaires Class 1, Division 2 Group.
6. Ratings below as indicated on drawings and in part numbers specified on the drawings:
    a. NEMA 4X
    b. IP 54
    c. IP 66
    d. IP 67

2.3 MATERIALS

A. Metal Parts:

1. Free of burrs and sharp corners and edges.
2. Sheet metal components shall be steel unless otherwise indicated.
3. Form and support to prevent warping and sagging.

B. Steel:

1. ASTM A36/A36M for carbon structural steel.
2. ASTM A568/A568M for sheet steel.

C. Stainless Steel:

1. 1. Manufacturer's standard grade.
2. 2. Manufacturer's standard type, ASTM A240/240M.

D. Galvanized Steel: ASTM A653/A653M.

E. Aluminum: ASTM B209.

2.4 METAL FINISHES

A. Variations in finishes are unacceptable in the same piece. Variations in finishes of adjoining components are acceptable if they are within the range of approved Samples and if they can be and are assembled or installed to minimize contrast.

2.5 LUMINAIRE SUPPORT

A. Comply with requirements in Section 260529 "Hangers and Supports for Electrical Systems" for channel and angle iron supports and nonmetallic channel and angle supports.

B. Single-Stem Hangers: Minimum 1/2-inch (13-mm) steel tubing with swivel ball fittings and ceiling canopy. Finish same as luminaire.

C. Wires: ASTM A641/A641M, Class 3, soft temper, zinc-coated steel, 12 gage (2.68 mm).

D. Rod Hangers: 3/16-inch (5-mm) minimum diameter, cadmium-plated, threaded steel rod.

E. Hook Hangers: Integrated assembly matched to luminaire, line voltage, and equipment with threaded attachment, cord, and locking-type plug.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine roughing-in for luminaire to verify actual locations of luminaire and electrical connections before luminaire installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Comply with NECA 1.

B. Install luminaires level, plumb, and square with ceilings and walls unless otherwise indicated.

C. Supports:

1. Sized and rated for luminaire weight.
2. Able to maintain luminaire position after cleaning and relamping.
3. Provide support for luminaire without causing deflection of ceiling or wall.
4. Luminaire-mounting devices shall be capable of supporting a horizontal force of 100 percent of luminaire weight and a vertical force of 400 percent of luminaire weight.

D. Flush-Mounted Luminaires:

1. Secured to outlet box.
2. Attached to ceiling structural members at two points equally spaced around circumference of luminaire.
3. Trim ring flush with finished surface.

E. Wall-Mounted Luminaires:

1. Attached to structural members in walls.
2. Do not attach luminaires directly to gypsum board.

F. Suspended Luminaires:

1. Pendants, Aircraft Cable and Rods: Where longer than 48 inches (1200 mm), brace to limit swinging.
2. Stem-Mounted, Single-Unit Luminaires: Suspend with twin-stem hangers. Support with approved outlet box and accessories that hold stem and provide damping of luminaire oscillations. Support outlet box vertically to building structure using approved devices.
3. Do not use ceiling grid as support for pendant luminaires. Connect support wires or rods to building structure.

G. Ceiling-Grid-Mounted Luminaires:

1. Secure to any required outlet box.
2. Use approved devices and support components to connect luminaire to ceiling grid and building structure in a minimum of two locations, spaced near corners of luminaire and connected directly to structure.

H. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables" for wiring connections.

3.3 IDENTIFICATION

A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

3.4 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:

1. Operational Test: After installing luminaires, switches, and accessories, and after electrical circuitry has been energized, test units to confirm proper operation.
2. Test for Emergency Lighting: Interrupt power supply to demonstrate proper operation. Verify transfer from normal power to battery power and retransfer to normal.

B. Luminaire will be considered defective if it does not pass operation tests and inspections.

3.5 ADJUSTING

A. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting the direction of aim of luminaires to suit occupied conditions. Make up to two visits to Project during other-than-normal hours for this purpose. Some of this work may be required during hours of darkness.

1. During adjustment visits, inspect all luminaires. Replace lamps or luminaires that are defective.
2. Parts and supplies shall be manufacturer's authorized replacement parts and supplies.

END OF SECTION 26 51 19

SECTION 26 52 13 - EMERGENCY AND EXIT LIGHTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Emergency lighting units.
2. Exit signs.
3. Luminaire supports.

1.3 DEFINITIONS

A. CCT: Correlated color temperature.

B. CRI: Color Rendering Index.

C. Emergency Lighting Unit: A lighting unit with internal or external emergency battery powered supply and the means for controlling and charging the battery and unit operation.

D. Fixture: See "Luminaire" Paragraph.

E. Lumen: Measured output of lamp and luminaire, or both.

F. Luminaire: Complete lighting unit, including lamp, reflector, and housing.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of emergency lighting unit, exit sign, and emergency lighting support.

1. Include data on features, accessories, and finishes.
2. Include physical description of the unit and dimensions.
3. Battery and charger for light units.

B. Shop Drawings: For nonstandard or custom luminaires.

1. Include plans, elevations, sections, and mounting and attachment details.

2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
3. Include diagrams for power, signal, and control wiring.

C. Product Schedule:

1. For emergency lighting units.
2. For exit signs.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For luminaires and lighting systems to include in emergency, operation, and maintenance manuals.

1.6 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Luminaire-mounted, emergency battery pack: One for every 50 emergency lighting units. Furnish at least one of each type.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Protect finishes of exposed surfaces by applying a strippable, temporary protective covering before shipping.

1.8 WARRANTY

A. Warranty: Manufacturer and Installer agree to repair or replace components of luminaires that fail in materials or workmanship within specified warranty period.

1. Warranty Period: Five year(s) from date of Substantial Completion.

B. Special Warranty for Emergency Lighting Batteries: Manufacturer's standard form in which manufacturer of battery-powered emergency lighting unit agrees to repair or replace components of rechargeable batteries that fail in materials or workmanship within specified warranty period.

1. Warranty Period for Emergency Power Unit Batteries: Five years from date of Substantial Completion. Full warranty shall apply for the entire warranty period.
2. Warranty Period for Self-Powered Exit Sign Batteries: Five years from date of Substantial Completion. Full warranty shall apply for the entire warranty period.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR EMERGENCY LIGHTING

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. NRTL Compliance: Fabricate and label emergency lighting units, exit signs, and batteries to comply with UL 924.

C. Comply with NFPA 70 and NFPA 101.

D. Comply with NEMA LE 4 for recessed luminaires.

E. Internal Type Emergency Power Unit: Self-contained, modular, battery-inverter unit, factory mounted within luminaire body.

1. Operation: Relay automatically turns lamp on when power-supply circuit voltage drops to 80 percent of nominal voltage or below. Lamp automatically disconnects from battery when voltage approaches deep-discharge level. When normal voltage is restored, relay disconnects lamps from battery, and battery is automatically recharged and floated on charger.
2. Battery: Sealed, maintenance-free, nickel-cadmium type.
3. Charger: Fully automatic, solid-state, constant-current type with sealed power transfer relay.
4. Integral Self-Test: Factory-installed electronic device automatically initiates code-required test of unit emergency operation at required intervals. Test failure is annunciated by an integral audible alarm and a flashing red LED.

F. External Type: Self-contained, modular, battery-inverter unit, suitable for powering one or more lamps, remote mounted from luminaire.

1. Operation: Relay automatically turns lamp on when power-supply circuit voltage drops to 80 percent of nominal voltage or below. Lamp automatically disconnects from battery when voltage approaches deep-discharge level. When normal voltage is restored, relay disconnects lamps from battery, and battery is automatically recharged and floated on charger.
2. Battery: Sealed, maintenance-free, nickel-cadmium type.
3. Charger: Fully automatic, solid-state, constant-current type.
4. Housing: NEMA 250, Type 1 enclosure listed for installation inside, on top of, or remote from luminaire. Remote assembly shall be located no less than half the distance recommended by the driver or emergency power unit manufacturer, whichever is less.
5. LED Indicator Light: Indicates normal power on. Normal glow indicates trickle charge; bright glow indicates charging at end of discharge cycle.
6. Integral Self-Test: Factory-installed electronic device automatically initiates code-required test of unit emergency operation at required intervals. Test failure is annunciated by an integral audible alarm and a flashing red LED.

2.2 EMERGENCY LIGHTING

A. Emergency Luminaires:

1. Emergency Luminaires: Interior Luminaire Schedule and Drawings.

    a. Operating at nominal voltage of 120 V ac or 277 V ac
    b. Internal emergency power unit.
    c. Rated for installation in damp locations, and for sealed and gasketed luminaires in wet locations.
    d. UL 94 flame rating.

B. Emergency Lighting Unit:

1. Emergency Lighting Unit: Interior Luminaire Schedule and Drawings.
2. Operating at nominal voltage of 120 V ac or 277 V ac
3. Wall or Ceiling mount as indicated on drawings, with universal junction box adaptor.
4. UV stable thermoplastic housing.
5. Two lamp heads.
6. Internal emergency power unit.

C. Remote Emergency Lighting Units:

1. Emergency Lighting Unit: As indicated on Interior Luminaire Schedule and Drawings.
2. Operating at nominal voltage of 120 V ac or 277 V ac
3. Wall or Ceiling mount as indicated on drawings, with universal junction box adaptor.
4. UV stable thermoplastic housing.
5. LED lamp heads.
6. External emergency power unit.

2.3 EXIT SIGNS

A. General Requirements for Exit Signs: Comply with UL 924; for sign colors, visibility, luminance, and lettering size, comply with authorities having jurisdiction.

B. Internally Lighted Signs:

1. Operating at nominal voltage of 120 V ac or 277 V ac
2. Lamps for AC Operation: LEDs; 50,000 hours minimum rated lamp life.
3. Self-Powered Exit Signs (Battery Type): Internal emergency power unit.

2.4 MATERIALS

A. Metal Parts:

1. Free of burrs and sharp corners and edges.
2. Sheet metal components shall be steel unless otherwise indicated.
3. Form and support to prevent warping and sagging.

B. Doors, Frames, and Other Internal Access:

1. Smooth operating, free of light leakage under operating conditions.
2. Designed to permit relamping without use of tools.
3. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position.

C. Housings:

1. Thermoplastic housing.
2. Clear finish.

D. Conduit: Electrical metallic tubing, minimum 3/4 inch (21 mm) in diameter.

2.5 METAL FINISHES

A. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

2.6 LUMINAIRE SUPPORT COMPONENTS

A. Comply with requirements in Section 260529 "Hangers and Supports for Electrical Systems" for channel and angle iron supports and nonmetallic channel and angle supports.

B. Support Wires: ASTM A641/A641M, Class 3, soft temper, zinc-coated steel, 12 gage (2.68 mm).

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for conditions affecting performance of luminaires.

B. Examine roughing-in for luminaire to verify actual locations of luminaire and electrical connections before luminaire installation.

C. Examine walls, floors, roofs, and ceilings for suitable conditions where emergency lighting luminaires will be installed.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Comply with NECA 1.

B. Install luminaires level, plumb, and square with ceilings and walls unless otherwise indicated.

3.3 IDENTIFICATION

A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

3.4 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:

1. Test for Emergency Lighting: Interrupt power supply to demonstrate proper operation. Verify transfer from normal power to battery power and retransfer to normal.

B. Luminaire will be considered defective if it does not pass operation tests and inspections.

3.5 STARTUP SERVICE

A. Perform startup service:

1. Charge emergency power units and batteries minimum of one hour and depress switch to conduct short-duration test.

3.6 ADJUSTING

A. Adjustments: Within 12 months of date of Substantial Completion, provide on-site visit to do the following:

1. Inspect all luminaires. Replace lamps, emergency power units, batteries, signs, or luminaires that are defective.

a. Parts and supplies shall be manufacturer's authorized replacement parts and supplies.

2. Conduct short-duration tests on all emergency lighting.

END OF SECTION 26 52 13

SECTION 26 56 19 – LED EXTERIOR LIGHTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Exterior solid-state luminaires that are designed for and exclusively use LED lamp technology.
2. Luminaire supports.
3. Luminaire-mounted photoelectric relays.

1.3 DEFINITIONS

A. CCT: Correlated color temperature.

B. CRI: Color rendering index.

C. Fixture: See "Luminaire."

D. LED: Light-emitting diode.

E. IP: International Protection or Ingress Protection Rating.

F. Lumen: Measured output of lamp and luminaire, or both.

G. Luminaire: Complete lighting unit, including lamp, reflector, and housing.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of luminaire.

1. Arrange in order of luminaire designation.
2. Include data on features, accessories, and finishes.
3. Include physical description and dimensions of luminaire.
4. Include life, output (lumens, CCT, and CRI), and energy-efficiency data.

a. Manufacturer's Certified Data: Photometric data certified by manufacturer's laboratory with a current accreditation under the NVLAP for Energy Efficient Lighting Products.

5. Wiring diagrams for power, control, and signal wiring.
6. Photoelectric relays.
7. Means of attaching luminaires to supports and indication that the attachment is suitable for components involved.

B. Shop Drawings: For nonstandard or custom luminaires.

1. Include plans, elevations, sections, and mounting and attachment details.
2. Include details of luminaire assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
3. Include diagrams for power, signal, and control wiring.

1.5 INFORMATIONAL SUBMITTALS

A. Sample warranty.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For luminaires and photoelectric relays to include operation and maintenance manuals.

1.7 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Diffusers and Lenses: One for every 50 of each type and rating installed.
2. Globes and Guards: One for every 50 of each type and rating installed.

1.8 QUALITY ASSURANCE

A. Provide luminaires from a single manufacturer for each luminaire type.

B. Each luminaire type shall be binned within a three-step MacAdam Ellipse to ensure color consistency among luminaires.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Protect finishes of exposed surfaces by applying a strippable, temporary protective covering prior to shipping.

1.10 FIELD CONDITIONS

A. Verify existing and proposed utility structures prior to the start of work associated with luminaire installation.

B. Mark locations of exterior luminaires for approval by Architect prior to the start of luminaire installation.

1.11 WARRANTY

A. Warranty: Manufacturer and Installer agree to repair or replace components of luminaires that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Structural failures, including luminaire support components.
b. Faulty operation of luminaires and accessories.
c. Deterioration of metals, metal finishes, and other materials beyond normal weathering.

2. Warranty Period: (2) Two years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Ambient Temperature: 41 to 104 deg F (5 to 40 deg C).

B. Altitude: Sea level to 1000 feet (300 m).

2.2 LUMINAIRE REQUIREMENTS

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. NRTL Compliance: Luminaires shall be listed and labeled for indicated class and division of hazard by an NRTL.

C. UL Compliance: Comply with UL 1598 and U.L. Listed for wet location if indicated.

D. Luminaire CRI: Minimum of 70 CRI unless noted otherwise or is specific to wildlife lighting requirements.

E. Luminaire CCT: 4000K unless noted otherwise on Drawings or is specific to wildlife lighting requirements.

F. Luminaire Rated Lamp Life: As comparable with luminaire model specified on Drawings.

G. Internal driver.

H. Nominal Operating Voltage: 120 V ac.

I. Standards:

1. ENERGY STAR certified.
2. RoHS compliant.
3. Recessed luminaires shall comply with NEMA LE 4.
4. UL Listing: Listed for damp or wet location as indicated on drawings and in part numbers specified on the drawings.
5. Industrial luminaires Class 1, Division 2 Group.

6. Ratings below as indicated on drawings and in part numbers specified on the drawings:
    a. NEMA 4X
    b. IP 54
    c. IP 66
    d. IP 67

2.3 MATERIALS

A. Metal Parts: Free of burrs and sharp corners and edges.

B. Sheet Metal Components: Corrosion-resistant aluminum or Stainless steel. Form and support to prevent warping and sagging.

C. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit relamping without use of tools. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position. Doors shall be removable for cleaning or replacing lenses.

D. Lens and Refractor Gaskets: Use heat- and aging-resistant resilient gaskets to seal and cushion lenses and refractors in luminaire doors.

E. Housings:

1. Rigidly formed, weather- and light-tight enclosure that will not warp, sag, or deform in use.
2. Provide filter/breather for enclosed luminaires.

F. Factory-Applied Labels: Comply with UL 1598. Labels shall be located where they will be readily visible to service personnel, but not seen from normal viewing angles where located in place.

1. Label shall include the following characteristics:

    a. CCT and CRI for all luminaires.

2.4 FINISHES

A. Variations in Finishes: Noticeable variations in same piece are unacceptable.

B. Luminaire Finish: Manufacturer's standard paint applied to factory-assembled and -tested luminaire before shipping. Where indicated, match finish process and color of pole or support materials.

C. Factory-Applied Finish for Aluminum Luminaires: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

1. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.

2. Natural Satin Finish: Provide fine, directional, medium satin polish (AA-M32); buff complying with AA-M20 requirements; and seal aluminum surfaces with clear, hard-coat wax.
3. Class I, Clear-Anodic Finish: AA-M32C22A41 (Mechanical Finish: Medium satin; Chemical Finish: Etched, medium matte; Anodic Coating: Architectural Class I, clear coating 0.018 mm or thicker) complying with AAMA 611.
4. Class I, Color-Anodic Finish: AA-M32C22A42/A44 (Mechanical Finish: Medium satin; Chemical Finish: Etched, medium matte; Anodic Coating: Architectural Class I, integrally colored or electrolytically deposited color coating 0.018 mm or thicker), complying with AAMA 611.

    a. Color: As selected from manufacturer's standard catalog of colors.

D. Factory-Applied Finish for Steel Luminaires: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

1. Surface Preparation: Clean surfaces to comply with SSPC-SP 1, to remove dirt, oil, grease, and other contaminants that could impair paint bond. Grind welds and polish surfaces to a smooth, even finish. Remove mill scale and rust, if present, from uncoated steel, complying with SSPC-SP 5/NACE No. 1 or SSPC-SP 8.
2. Exterior Surfaces: Manufacturer's standard finish consisting of one or more coats of primer and two finish coats of high-gloss, high-build polyurethane enamel.

    a. Color: As selected from manufacturer's standard catalog of colors.

2.5 LUMINAIRE SUPPORT COMPONENTS

A. Comply with requirements in Section 260529 "Hangers and Supports for Electrical Systems" for channel and angle iron supports and nonmetallic channel and angle supports.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine roughing-in for luminaire electrical conduit to verify actual locations of conduit connections before luminaire installation.

C. Examine walls, roofs, canopy ceilings and overhang ceilings for suitable conditions where luminaires will be installed.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 GENERAL INSTALLATION REQUIREMENTS

A. Comply with NECA 1.

B. Fasten luminaire to structural support.

C. Supports:

1. Sized and rated for luminaire weight.
2. Able to maintain luminaire position after cleaning and relamping.
3. Support luminaires without causing deflection of finished surface.
4. Luminaire-mounting devices shall be capable of supporting a horizontal force of 100 percent of luminaire weight and a vertical force of 400 percent of luminaire weight.

D. Wall-Mounted Luminaire Support:

1. Attached to structural members in walls.
2. Do not attach luminaires directly to gypsum board.

E. Wiring Method: Install cables in raceways. Conceal raceways and cables.

F. Install luminaires level, plumb, and square with finished grade unless otherwise indicated. Install luminaires at heights as indicated on Drawings.

G. Coordinate layout and installation of luminaires with other construction.

H. Adjust luminaires that require field adjustment or aiming.

I. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables" and Section 260533 "Raceways and Boxes for Electrical Systems" for wiring connections and wiring methods.

3.3 BOLLARD LUMINAIRE INSTALLATION:

A. Align units for optimum directional alignment of light distribution.

1. Install on concrete base with top 6 inches above finished grade or surface at luminaire location. Cast conduit into base, and shape base to match shape of bollard base. Finish by troweling and rubbing smooth. Concrete materials, installation, and finishing are specified in Section 033000 "Cast-in-Place Concrete."

3.4 INSTALLATION OF INDIVIDUAL GROUND-MOUNTED LUMINAIRES

A. Install on concrete base with top 6 inches above finished grade or surface at luminaire location. Cast conduit into base, and finish by troweling and rubbing smooth. Concrete materials, installation, and finishing are specified in Section 033000 "Cast-in-Place Concrete."

3.5 CORROSION PREVENTION

A. Aluminum: Do not use in contact with earth or concrete. When in direct contact with a dissimilar metal, protect aluminum by insulating fittings or treatment.

3.6 IDENTIFICATION

A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

3.7 FIELD QUALITY CONTROL

A. Inspect each installed luminaire for damage. Replace damaged luminaires and components.

1. Operational Test: After installing luminaires, switches, and accessories, and after electrical circuitry has been energized, test units to confirm proper operation.

B. Luminaire will be considered defective if it does not pass tests and inspections.

3.8 ADJUSTING

A. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting the direction of aim of luminaires to suit occupied conditions. Make up to two visits to Project during other-than-normal hours for this purpose. Some of this work may be required during hours of darkness.

1. During adjustment visits, inspect all luminaires. Replace lamps or luminaires that are defective.
2. Parts and supplies shall be manufacturer's authorized replacement parts and supplies.
3. Adjust the aim of luminaires in the presence of the Architect.

END OF SECTION 26 56 19